

# LARGE FILING SEPARATOR SHEET

CASE NUMBER *12-1727-EL-BSTB*

FILE DATE *11/9/2012*

SECTION: *2 OF 4*

NUMBER OF PAGES: *200*

DESCRIPTION OF DOCUMENT: *Application*

This is to certify that the images appearing are an  
accurate and complete reproduction of a case file  
document delivered in the regular course of business  
Technician *fe* Date Processed **NOV 09 2012**



## Appendix 2-1



## **First Energy Generator Deactivation Request - January 2012**

### **Deactivation Study Results and Required Upgrades – April 25, 2012**

#### **General**

PJM received a notice on January 26, 2012 from FirstEnergy of its intent to deactivate through retirement the following generating units by not later than September 1, 2012:

|                 |        |
|-----------------|--------|
| Armstrong 1     | 172 MW |
| Armstrong 2     | 171 MW |
| Ashtabula 5     | 244 MW |
| Bay Shore 2     | 138 MW |
| Bay Shore 3     | 172 MW |
| Bay Shore 4     | 215 MW |
| Eastlake 1      | 132 MW |
| Eastlake 2      | 132 MW |
| Eastlake 3      | 132 MW |
| Eastlake 4      | 240 MW |
| Eastlake 5      | 597 MW |
| Lake Shore 18   | 245 MW |
| R. Paul Smith 3 | 28 MW  |
| R. Paul Smith 4 | 87 MW  |

#### **Reliability Analysis:**

PJM Interconnection Analysis (and affected Transmission Owners) performed a study of the Transmission System and found significant reliability concerns resulting from the deactivation of these generating units. In all, more than 190 reliability violations were identified in this deactivation analysis. A summary of the reliability impacts resulting from the proposed Deactivations include:

**1. N-1 Common Mode Voltage Violations:**

- Ten low voltage violations on the 138 kV system

**2. N-1-1 Thermal Violations:**

- Six 138 kV thermal violations in the Allegheny Power zone
- Thirty 138 kV and 345kV thermal violations in the ATSI zone
- Two 230 / 115 kV thermal violations (transformers) in the PenElec zone
- Ten 138 kV thermal violations in the AEP zone

**3. N-1-1 Voltage Violations:**

- Ninety-two low voltage violations in the ATSI zone

**4. Generator Deliverability Violations:**

- Twenty-six 138 kV and 345 kV overloaded facilities in the ATSI zone.
- One 138 kV overload facility in the Allegheny Power zone.
- Seven 115 kV and 345 kV overloaded facilities in the PenElec zone.
- Eight 345 kV and 138 kV overloads in the AEP zone.

**5. Load Deliverability Violations:**

- One voltage collapse violation observed in the ATSI zone
- One 345 kV overload on an AEP / ATSI facility

**Study Results and Required Upgrades:**

The following generating units will be deactivated on September 1, 2012:

Armstrong 1  
 Armstrong 2  
 Bay Shore 2  
 Bay Shore 3  
 Bay Shore 4  
 Eastlake 4      Note: will be converted to synchronous condenser (expected completion Dec. 1, 2013)  
 Eastlake 5      Note: will be converted to synchronous condenser (expected completion June 1, 2013)  
 R. Paul Smith 3  
 R. Paul Smith 4

The following generating units will continue to operate as upgrades to the transmission system are constructed:

Ashtabula 5  
 Eastlake 1  
 Eastlake 2  
 Eastlake 3  
 Lake Shore 18

Required transmission upgrades and expected completion date:

**ATSI zone:**

- Install a 50 MVAR capacitor bank at the Maclean 138 kV station      6/1/2013
- Install a 345/138 kV transformer at the Inland Q-11 station      6/1/2013
- Install a 138 kV circuit breaker at the Inland Q-11 station      6/1/2013
- Upgrade terminal equipment on the Avon – Crestwood 138 kV line      6/1/2013
- Eastlake unit 5 to be converted to synchronous condenser      6/1/2013
- Eastlake unit 4 to be converted to synchronous condenser      12/1/2013
- Eastlake units 1, 2 and 3 to be converted to synchronous condensers      6/1/2015
- Lakeshore unit 18 to be converted to synchronous condenser      6/1/2015

- Loop the Chamberlin - Mansfield 345 kV line into the Hanna 345 kV substation (existing baseline upgrade b1283) 6/1/2014 (advanced from 6/2015)
- Build new Hayes 345/138 kV substation with new 138 kV lines to: Greenfield #1, Greenfield #2, and Avery (existing baseline upgrade b1281) 6/1/2014 (advanced from 6/2015)
- Build Beaver - Hayes - Davis Besse #2 345 kV line (existing base line upgrade b1282) 6/1/2014 (advanced from 6/2015)
- Re-conductor the Galion - Leaside 138 kV line 6/1/2014
- Re-conductor the Galion - GM Mansfield - Ontario - Cairns 138 kV line 6/1/2014
- Install a 2<sup>nd</sup> 345/138 kV transformer at the Allen Junction station 6/1/2014
- Install a 2<sup>nd</sup> 345/138 kV transformer at the Bay Shore station 6/1/2014
- Create a new Northfield Area 345 kV switching station by looping in the Eastlake - Juniper 345 kV line and the Perry - Inland 345 kV line 6/1/2015
- Build a new Mansfield - Northfield Area 345 kV line 6/1/2015
- Create a new Harmon 345/138/69 kV substation by looping in the Star - South Canton 345 kV line 6/1/2015
- Build a new Harmon - Brookside + Harmon - Longview 138 kV line 6/1/2015
- Create a new Five Points Area 345/138 kV substation by looping in the Lemoyne - Midway 345 kV line 6/1/2015
- Install a 50 MVAR capacitor at Hayes 138 kV 6/1/2015
- Install a 138/69 kV transformer at the Avery station 6/1/2015
- Increase design temperature limitation on the Avery - Hayes 138 kV line by raising the existing structures 6/1/2015
- Reconductor Cloverdale - Harmon #2 and #3 138kV lines and Terminal upgrades 6/1/2015
- Change the transformer tap settings on the Maclean 138/69 kV transformers 6/1/2015
- Upgrade the Richland - Naomi 138 kV line 6/1/2015
- ATSI-AEP 138kV Substation on / near territory border and 138kV from new substation to Longview 6/1/2016, working on potential operating procedure to mitigate impacts until this upgrade complete
- Build new Allen Jct - Midway - Lemoyne 345kV line 6/1/2016, but operating procedure in place to mitigate impacts until this upgrade complete
- Build a new Leroy Center 345/138 kV substation by looping in the Perry - Harding 345 kV line 6/1/2016, but operating procedure in place to mitigate impacts until this upgrade complete
- Place a portion of the 138 kV Leroy Center 345/138 kV project into service by summer 2015 6/1/2015
- Reconductor the Barberton - West Akron 138 kV line 6/1/2016, but operating procedure in place to mitigate impacts until this upgrade complete

AP zone:

- Replace breaker risers at Marlowe 138 kV and wave traps at Marlowe 138 kV and Bedington 138 kV 6/1/2013
- Replace line trap at Stonewall on the Stephenson 138 kV line terminal (existing base line upgrade b1902) 6/1/2013
- Loop the Homer City-Handsome Lake 345 kV line into the Armstrong substation and install a 345/138 kV transformer at Armstrong 6/1/2014
- Change the CT ratio at Millville 6/1/2015

- Install a new Buckhannon – Weston 138 kV line 6/1/2016, but operating procedure in place to mitigate impacts until this upgrade complete

PenElec zone:

- Construct Four Mile Junction 230/115 kV substation (existing baseline upgrade b1609) 6/1/2014
- Construct a 115 kV ring bus at Claysburg Substation 6/1/2015
- Reconductor Eclipse substation 115 kV bus 6/1/2013
- Install second 230/115 kV autotransformer at Johnstown 6/1/2015

AEP zone:

- Reconductor AEP portion of South Canton – Star 345 kV line and upgrade terminal equipment at South Canton (existing base line upgrade b1812) 12/31/2013
- Advance baseline upgrade b1901 (Rebuild the Ohio Central – West Trinway (4.84 miles) section of the Academia – Ohio Central 138 kV circuit. Upgrade the Ohio Central riser, Ohio Central switch and the West Trinway riser) 6/1/2015
- Advance baseline upgrade b1868 (Perform a sag study on the 05E LIMA – New Liberty 138 kV line) 6/1/2015
- Advance the rebuild portion of the baseline upgrade b1819 (Rebuild the Robinson Park - Sorenson 138 kV line corridor as a 345 kV double circuit line with one side operated at 345 kV and one side at 138 kV) 6/1/2015
- Advance 2016 baseline project b1733 (Perform a sag study of the Bluff Point - Jay 138 kV line.) Upgrade breaker, wavetrap, and risers at the terminal ends). 12/1/2014
- Perform a sag study on the Brues – West Bellaire 138 kV line 12/1/2014
- Advance Baseline project b1865 (Perform a Sag study on the Kanawha – Carbondale 138 KV line) 12/1/2014
- Sag study of the Dequine - Meadowlake 345 kV line #1 12/1/2013
- Sag study of the Dequine - Meadowlake 345 kV line #2 12/1/2013
- Advance baseline project b1868 (Perform sag study of the East Lima – New Liberty 138kV line) 12/1/2014
- Establish a new 765/345 interconnection at Sporn. Install a 765/345 kV transformer at Mountaineer and build ¾ mile of 345 kV to Sporn. 6/1/2015
- Perform a sag study on the Grant Tap – Deer Creek 138 kV line and replace bus and risers at Deer Creek station 12/1/2014
- Advance baseline project b1436 (Perform a sag study on the Sorenson - Illinois Road 138kV line). Replace bus and risers at Illinois Road. 12/1/2014
- Perform a sag study on the Kammer – Ormet 138 kV line 12/1/2012
- Perform a sag study of the Maddox- Convoy 345 kV line 12/1/2013
- Perform a sag study of the Maddox – T130 345 kV line 12/1/2013
- Perform a sag study of the Meadowlake - Olive 345 kV 12/1/2013
- Perform a sag study on the Milan - Harper 138 kV line and replace bus and switches at Milan Switch station 12/1/2014
- Advance baseline project b1871 (Perform a sag study on the Ohio Central – West Coshocton 138KV line). 12/1/2014
- Perform a sag study of the R-049 - Tillma 138 kV line 12/1/2013
- Advance 2016 Baseline project B1734 (Perform a sag study of Randolph - Hodgins 138 kV line. Upgrade terminal equipment). 12/1/2014

- South Canton – Harmon 345 kV line - advance baseline project b1812 (rebuild AEP portion of line). Also upgrades risers, wavetrap and bus work at South Canton station. 6/1/2015
- Perform a sag study of the Tillma - Dawkins 138 kV line 12/1/2013
- Advance baseline project b1738 (Perform a sag study of the Wolf Creek - Layman 138 kV line. Upgrade terminal equipment including a 138 kV breaker and wavetrap). 12/1/2014
- Advance baseline project b1883 (Switch the breaker position of transformer #1 and SW Lima at East Lima 345 kV bus). 12/1/2014
- Terminate Transformer #2 at SW Lima in a bay position 12/1/2014
- Perform a sag study on the Brookside - Howard 138 kV line and replace bus and risers at AEP Howard station 12/1/2014





# Transmission Expansion Advisory Committee

April 27, 2012



# Issues Tracking



## Issues Tracking

- Open Issues
  - None
- New Issues

# Generation Deactivation Notification (Retirements) Update



Over 16,000 MW of Pending Deactivations  
(~13,500 MW since 11/2011)



# Deactivation Status

|                                                                                              |      |            |                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------|------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chesapeake 1 & 2, Yorktown 1                                                                 | DOM  | 12/31/2014 | Reliability Analysis complete. Impacts identified. Upgrades expected to be completed by June 2015.                                                                                                            |
| Chesapeake 3 & 4                                                                             | DOM  | 12/31/2015 | Reliability Analysis complete. Impacts identified. Upgrades expected to be completed by June 2016.                                                                                                            |
| Bergen 3; Burlington 8; National Park 1; Mercer 3; Seward 6                                  | PSEG | 6/1/2015   | Reliability Analysis Complete. Impacts identified and expected to be resolved in three - four years. Working with affected TO to finalize upgrade schedule.                                                   |
| Armstrong 1 & 2; Ashtabula 5; Bayshore 2-4; Eastlake 1-5; Lake Shore 18; R Paul Smith 3 & 4; | AP   | 9/1/2012   | Reliability analysis complete. Impacts identified and expected to be resolved by June 2016. Further refinement of the reliability analysis, required upgrades, and generator deactivation schedule continues. |
| Walter C Beckjord 1                                                                          | DEOK | 5/1/2012   | Reliability Analysis complete - no impacts identified.                                                                                                                                                        |
| Walter C Beckjord 2-6                                                                        | DEOK | 4/1/2015   | Reliability Analysis complete - impacts identified - upgrades scheduled to be completed by June 2014                                                                                                          |
| Albright 1-3; Rivesville 5 & 6; Willow Island 1 & 2                                          | APS  | 9/1/2012   | Reliability Analysis complete - impacts identified - upgrades scheduled to be completed by May 2013                                                                                                           |
| New Castle 3-5; New Castle Diesels A & B                                                     | ATSI | 4/16/2015  | Reliability Analysis complete - impacts identified - upgrades scheduled to be completed by June 2015                                                                                                          |



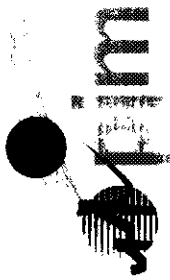
## Deactivation Status

|                                                                                                                                           |         |            |                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|------------------------------------------------------------------------------------------------------|
| Portland 1 & 2; Glen Gardner CT 1-8                                                                                                       | MetEd   | 1/7/2015   | Reliability Analysis complete - impacts identified - upgrades scheduled to be completed by June 2016 |
| Elrama 1-4                                                                                                                                | DUQ     | 6/1/2012   | Reliability Analysis complete - impacts identified - upgrades scheduled to be completed by June 2014 |
| Shawville 1-4; Titus 1-3                                                                                                                  | PenElec | 4/16/2015  | Reliability Analysis complete - impacts identified - upgrades scheduled to be completed by June 2016 |
| Niles 1 & 2                                                                                                                               | ATSI    | 6/1/2012   | Reliability Analysis complete - impacts identified - upgrades scheduled to be completed by June 2014 |
| Fisk Street 19, Crawford 7 & 8                                                                                                            | ComEd   | 12/31/2012 | Reliability Analysis Complete. No impacts identified.                                                |
| Conesville 3                                                                                                                              | AEP     | 12/31/2012 | Reliability Analysis Underway                                                                        |
| Big Sandy 1; Clinch River 3; Glen Lyn 5 & 6; Kammer 1-3; Kanawha River 1 & 2; Muskingum River 1-4; Pickway 5; Sporn 1-4; Tanner Creek 1-3 | AEP     | 6/1/2015   | Reliability Analysis Underway                                                                        |



# Deactivation Status

| Avon Lake 7 & 9                                        | ATSI | 4/16/2015 | Reliability Analysis Underway                                                                                 |  |
|--------------------------------------------------------|------|-----------|---------------------------------------------------------------------------------------------------------------|--|
| Sewaren 1-4                                            | PSEG | 6/1/2015  | Reliability Analysis Underway. PSEG also contemplating re-use of Capacity Rights for a new generation project |  |
| Cedar 1 & 2; Deepwater 1 & 6; Missouri Ave CT B, C & D | AE   | 5/31/2015 | Reliability Analysis Underway                                                                                 |  |

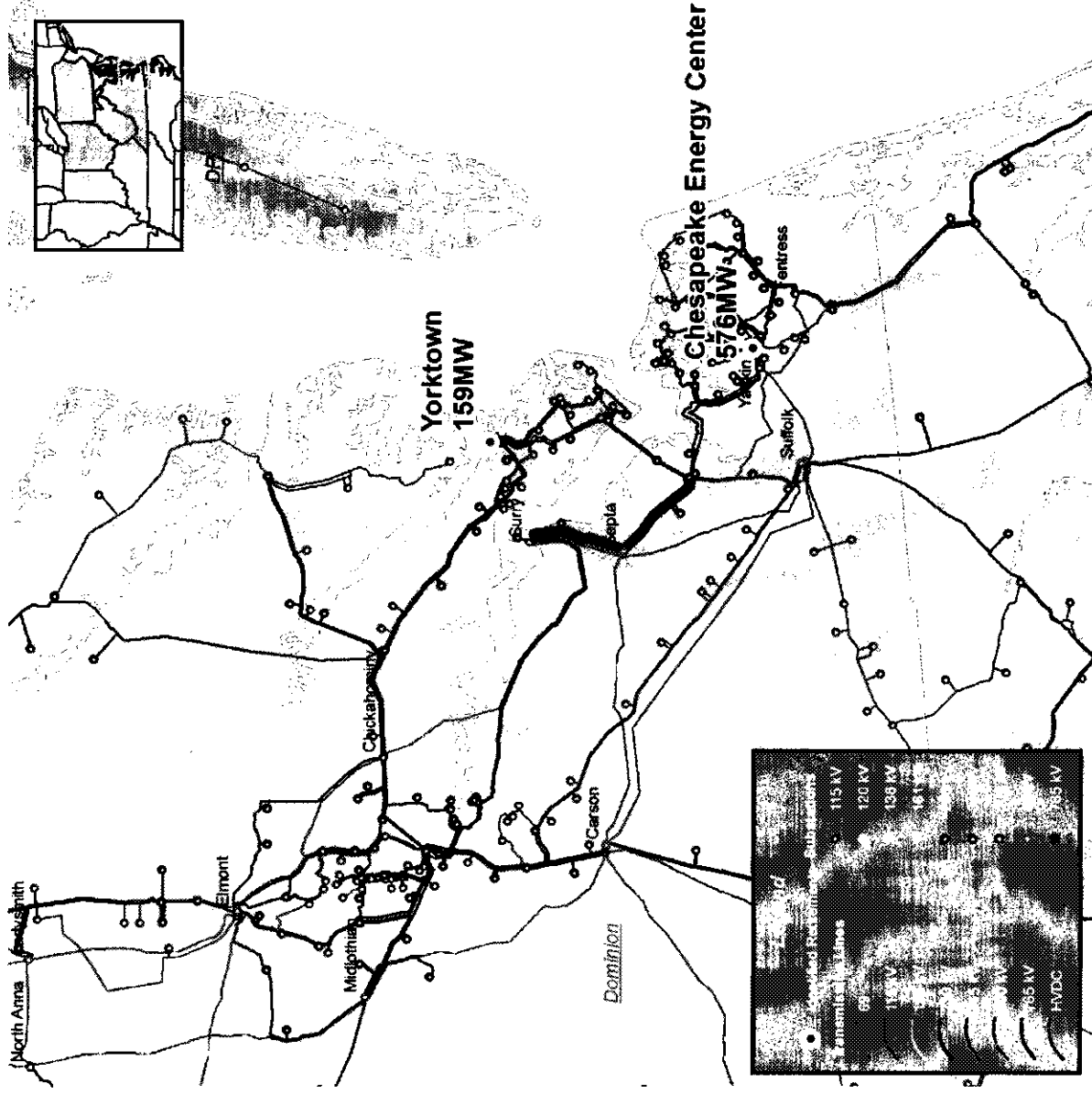


# Chesapeake #1-4 & Yorktown #1 Deactivation



# Chesapeake and Yorktown Deactivation Notifications

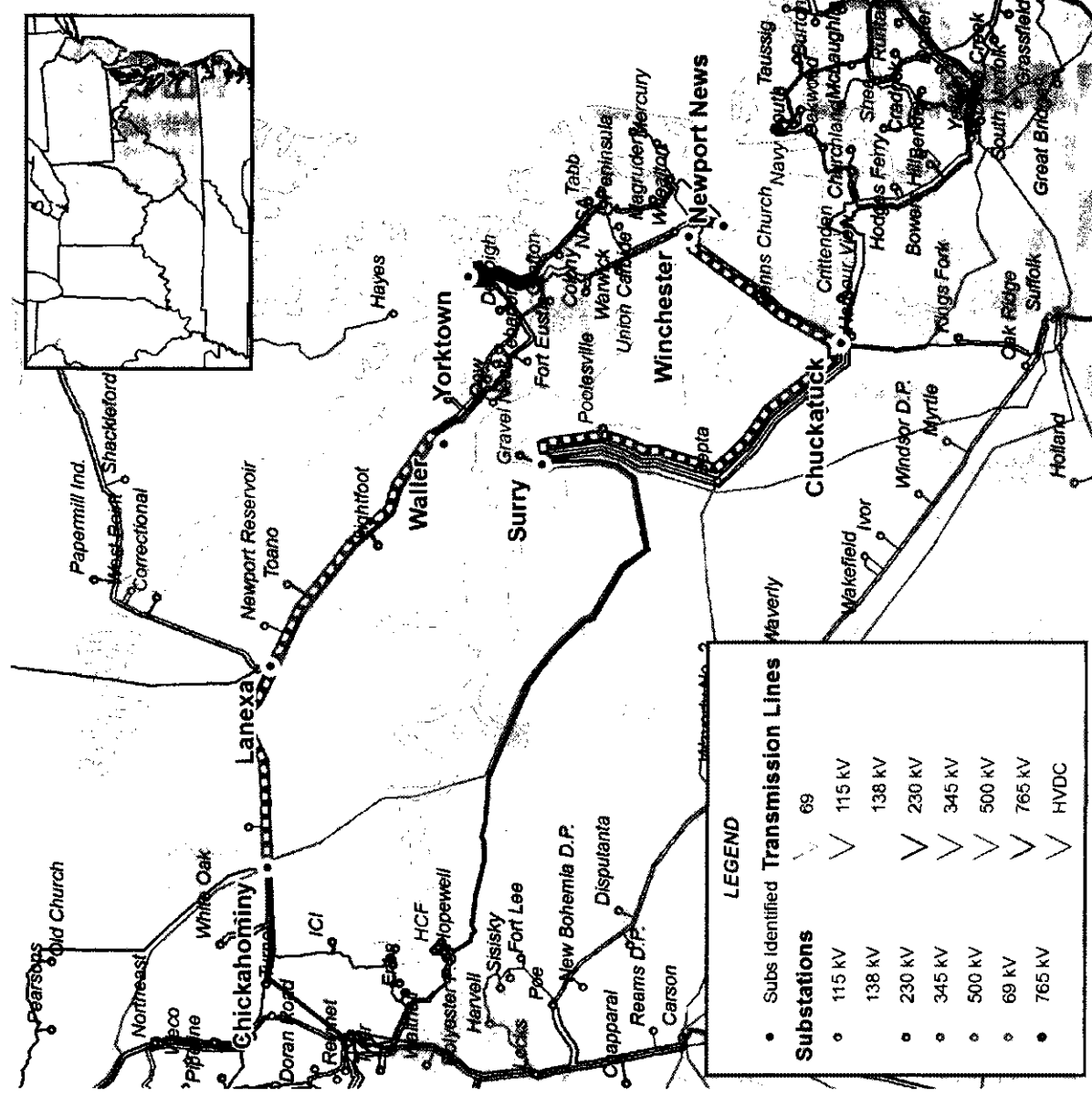
- Deactivation Notifications:
  - Chesapeake Units 1-2 & Yorktown 1
    - 381 MW
    - Requested Retirement Date: December 31, 2014
  - Chesapeake 3&4
    - 354 MW
    - Requested Retirement Date: December 31, 2015





# 

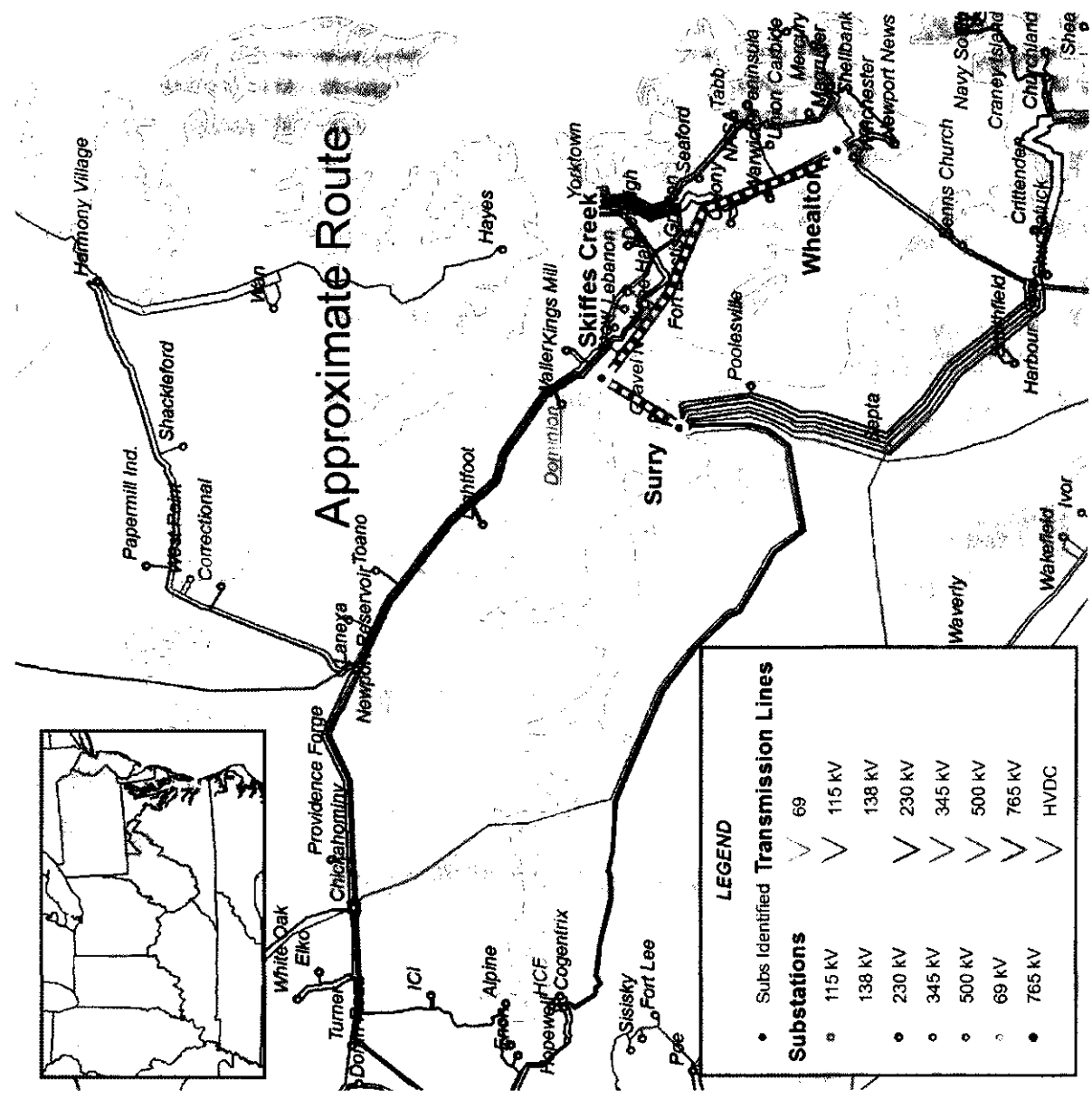
- Dominion Criteria – critical system conditions of Yorktown #3 outage
- N-1 Thermal Overloads (All conductor limits)
  - Chuckatuck – Newport News 230 kV is overloaded for the loss of Surry – Winchester 230 kV
  - Surry - Winchester 230 kV is overloaded for the loss of Chuckatuck – Newport News 230 kV
  - Lanexa – Waller 230 kV is overloaded for the loss of Chickahominy – Waller 230 kV
- James River Crossing Double Circuit Towerline overloads (All conductor limits)
  - Chickahominy – Waller 230 kV, Lanexa – Waller 230 kV, and Yorktown – Wheelton 230 kV
- Also, voltage collapse for the James River Crossing Double Circuit Towerline outage
- Several solution alternatives evaluated







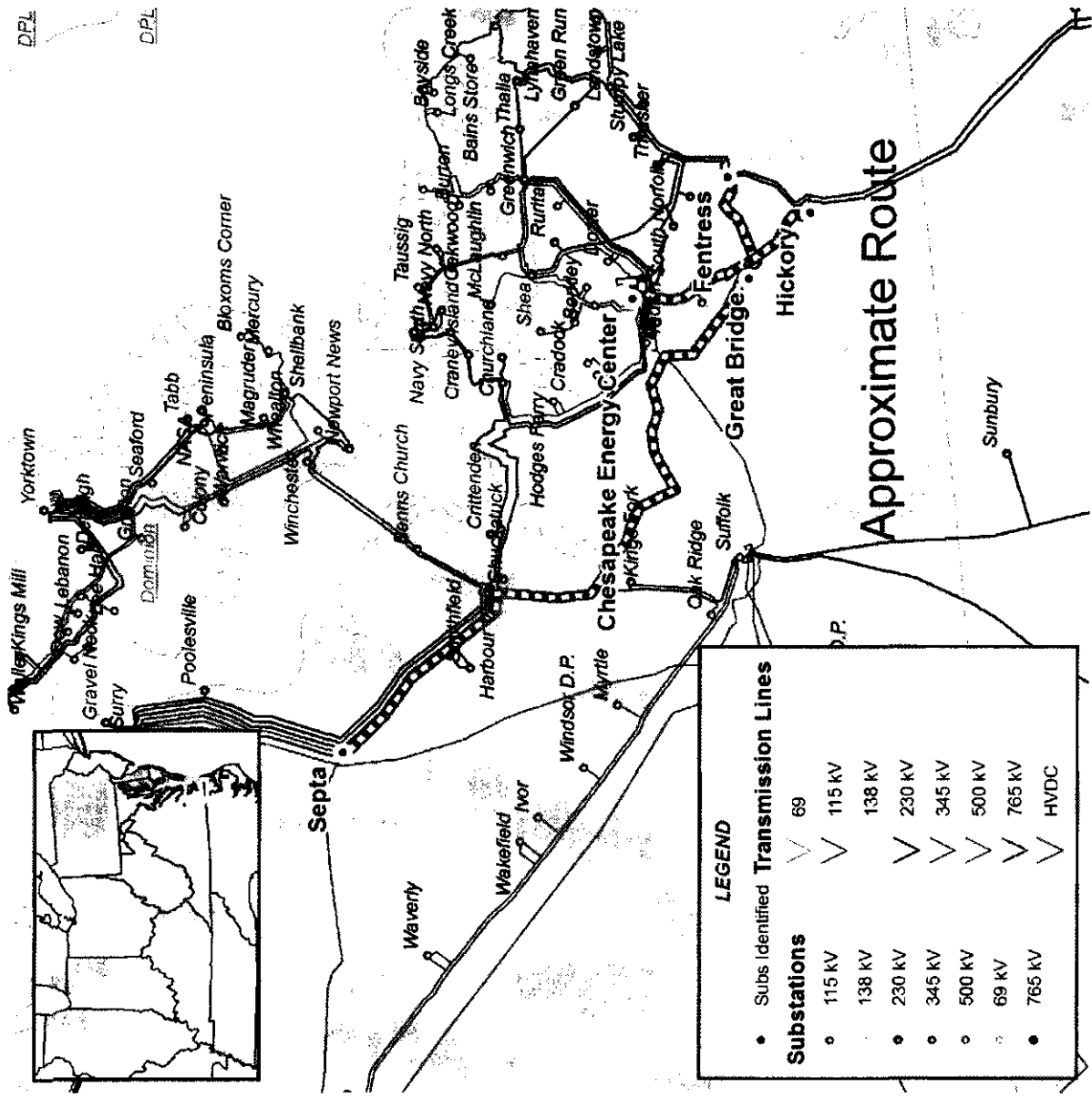
- **Dominion Proposed Solution**
- **Surry to Skiffes Creek 500 kV Line \$58.3 M**
  - 7.7 miles total (3 miles already existing Dominion ROW)
- **Surry 500 kV Station Work \$1.5 M**
- **Skiffes Creek 500-230 kV Tx and Switching Station \$42.4 M**
- **New Skiffes Creek - Whealton 230 kV Line \$46.4 M**
- **Whealton 230 kV Breakers \$2.1 M**
- **Yorktown 230 kV Work \$0.2 M**
- **Lanexa 115 kV Work \$0.13M**
- **Surry 230 kV Work \$0.13 M**
- **Kings Mill, Peninmen, Toano, Waller, Warwick \$ 0.03 M**
- **Estimated project cost: \$151.19 M**





# Great Bridge & Surry 230 kV Alternative

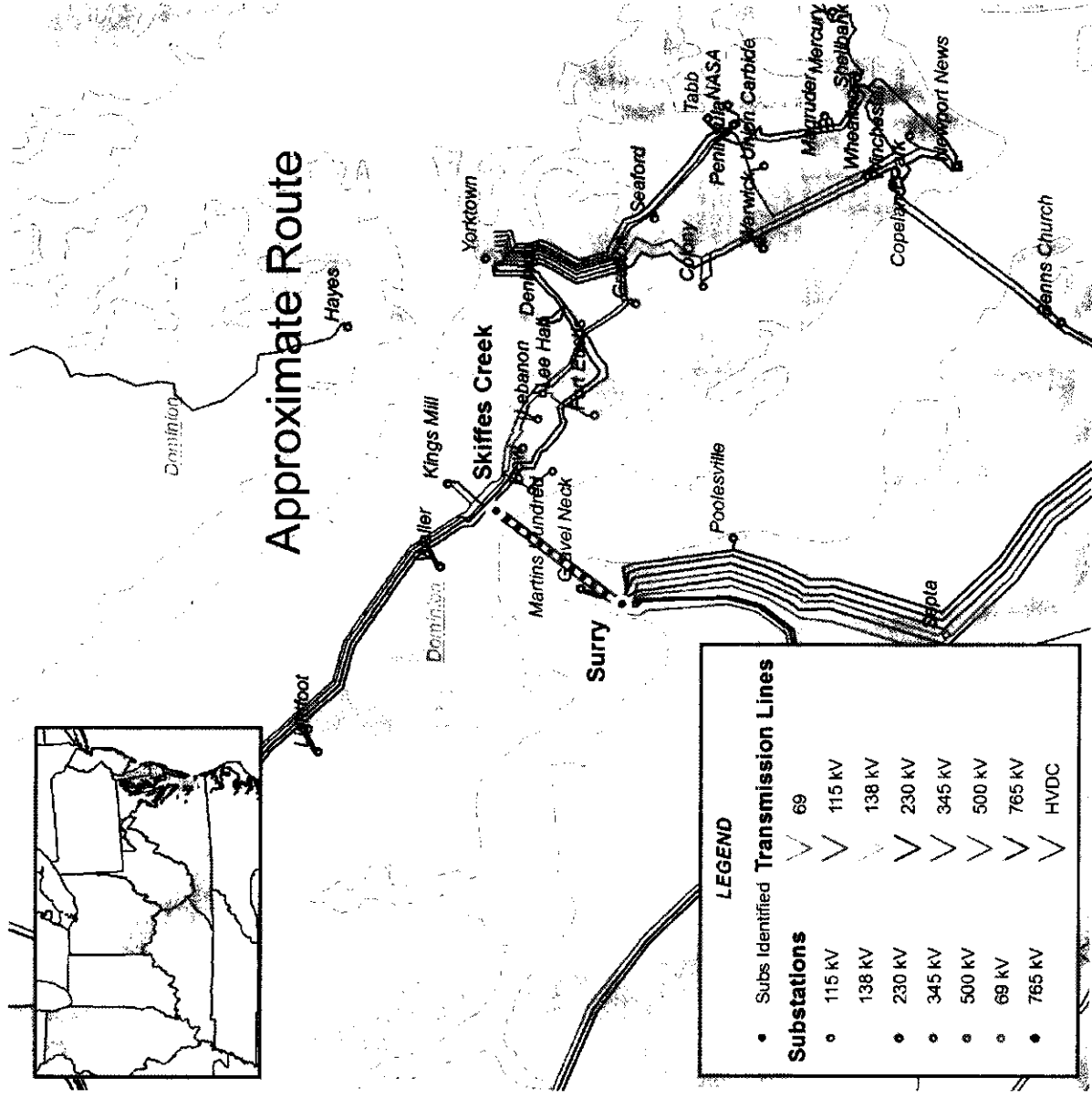
- LS Power / Northeast Transmission Development Proposed
- Build a new Great Bridge 500 kV substation (3 breaker ring bus) along existing Fentress-Septa 500 kV circuit.
- Build a new Great Bridge 115 kV substation at the intersection of the Fentress-Septa 500 kV circuit and the Hickory-Great Bridge 115 kV circuit.
- Install a new Great Bridge 500/115 kV transformer.
- Reconnector Great Bridge-Chesapeake 115 kV with high temperature conductor.
- Install a second Yorktown 230/115 kV transformer.
- New Surry-Skiffes Creek single circuit 230 kV line in series with a PAR at Surry.
- \$99 M for Surry – Skiffes Creek 230 kV plus the cost of the Great Bridge and Yorktown area work





## Surry 230 kV Partial Alternative

- 230 kV Alternative to the 500 kV portions of the Chickahominy 500 kV and Surry 500 kV proposals
- Construct a New Surry - Skiffes Creek single circuit 230 kV line  
\$84 M
  - Total length approximately 7.33 miles
  - ~3 miles underground/underwater
- Construct a Phase Angle Regulator in series with Surry - Skiffes Creek 230 kV at Surry \$15 M
- Estimated project cost: \$99 M





## Alternative Performance Comparison

- Great Bridge & Surry 230 kV Alternative
  - Does not address several key criteria violations
- Analytical focus on other three alternatives
  - Chickahominy 500 kV Alternative
  - Surry 500 kV Alternative
  - Surry 230 kV Partial Alternative



## Alternative Performance Comparison

- Chickahominy 500 kV Alternative, Surry 500 kV Alternative and Surry 230 kV Partial Alternative performance in the near term
  - All solved the applicable criteria violations
    - N-1-1
    - Generator Deliverability
    - Load Deliverability
    - Dominion Critical Condition criteria
  - Surry 230 kV Partial Alternative solution acceptable in near term but with small margin on thermal limits
- Sensitivity of at-risk generation (Yorktown #2)
  - Surry 230 kV Partial Alternative demonstrates a thermal overload of Lanexa – Waller 230 kV and the proposed Phase Angle Regulator
  - No performance issues for Chickahominy 500 kV and Surry 500 kV



## Alternative Cost Comparison

- **Proposed Alternative to Dominion 500 kV scope of work**
  - Surry 500 kV scope of work
    - Surry to Skiffes Creek 500 kV Line (7 miles overhead) \$58.3 M
    - Surry 500 kV Station Work \$1.5 M
    - Skiffes Creek 500-230 kV Tx and Switching Station \$25 M
    - **Total Surry 500 kV alternative and associated work: \$84.8 M as estimated by Dominion**
  - Surry 230 kV scope of work
    - New Surry to Skiffes Creek 230 kV Line (4 miles overhead / 3 miles underwater) \$84 M
    - Install new 230 kV Phase Angle Regulator (PAR) in series with the new Surry to Skiffes Creek 230 kV \$15 M
    - **Total Surry 230 kV alternative and associated work: \$99 M as estimated by LS Power**



## Proposed Solution Considerations

### Surry 230 kV Partial

#### Surry 500 kV

#### Chickahominy 500 kV

- |                                                                                                                                                                                                                             |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• ROW                         <ul style="list-style-type: none"> <li>– Dominion Owned</li> </ul> </li> <li>• Siting process / timeline</li> <li>• Estimated cost: \$134.8</li> </ul> | <ul style="list-style-type: none"> <li>• ROW                         <ul style="list-style-type: none"> <li>– mostly Dominion Owned</li> </ul> </li> <li>• Siting process / timeline</li> <li>• Estimated cost: \$84.8 M</li> </ul> | <ul style="list-style-type: none"> <li>• ROW                         <ul style="list-style-type: none"> <li>– Expansion limitations at Surry 230 kV</li> </ul> </li> <li>• Phase Angle Regulator                         <ul style="list-style-type: none"> <li>– Siting</li> <li>– Added operational complexity of a PAR</li> </ul> </li> <li>• Siting process / timeline</li> <li>• Estimated cost: \$99 M</li> </ul> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



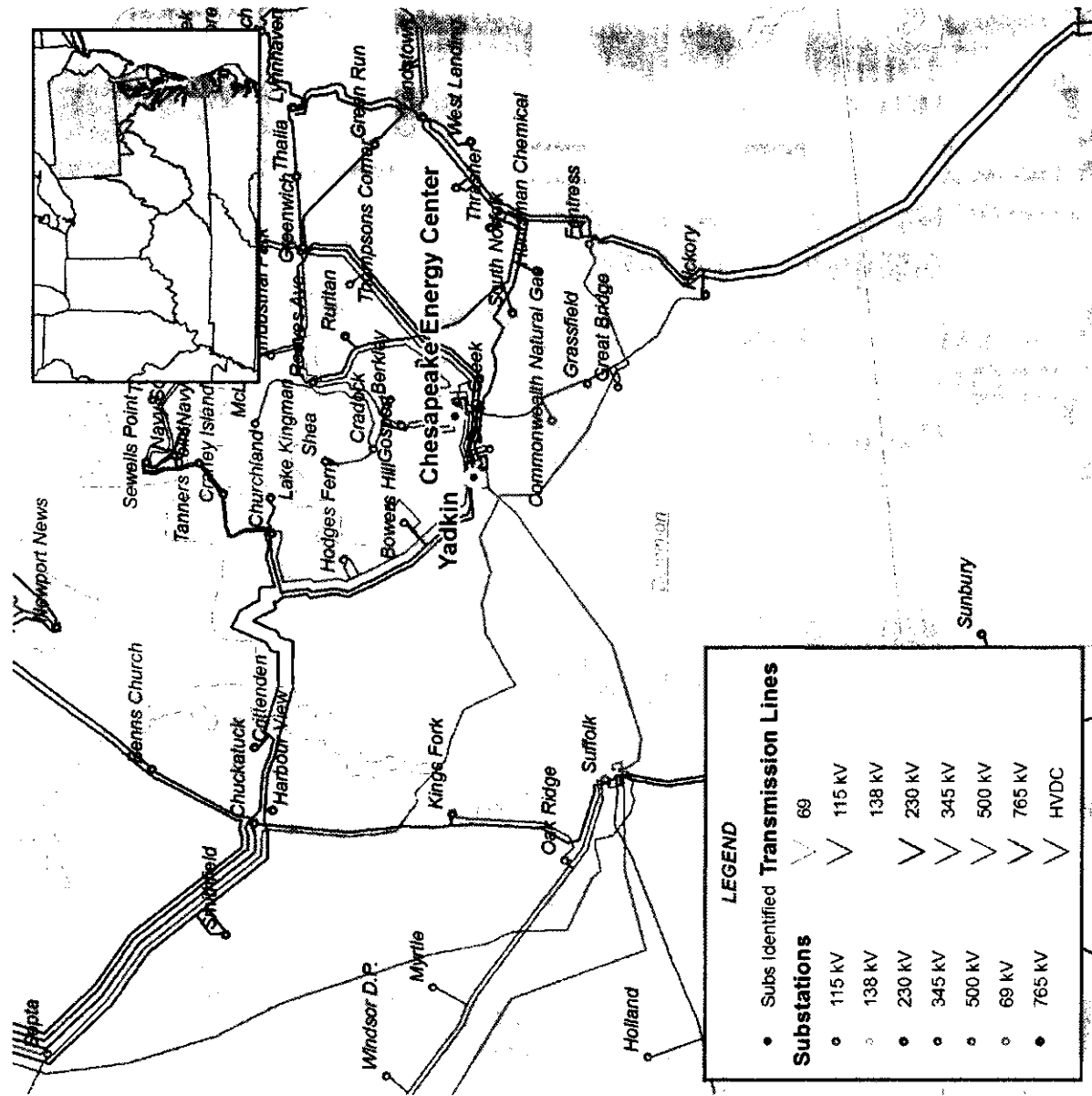
## Proposed Solution

- Recommended solution:
  - Surry 500 kV alternative
- Assign construction responsibility to Dominion



## Additional Required Dominion Transmission Zone Upgrade

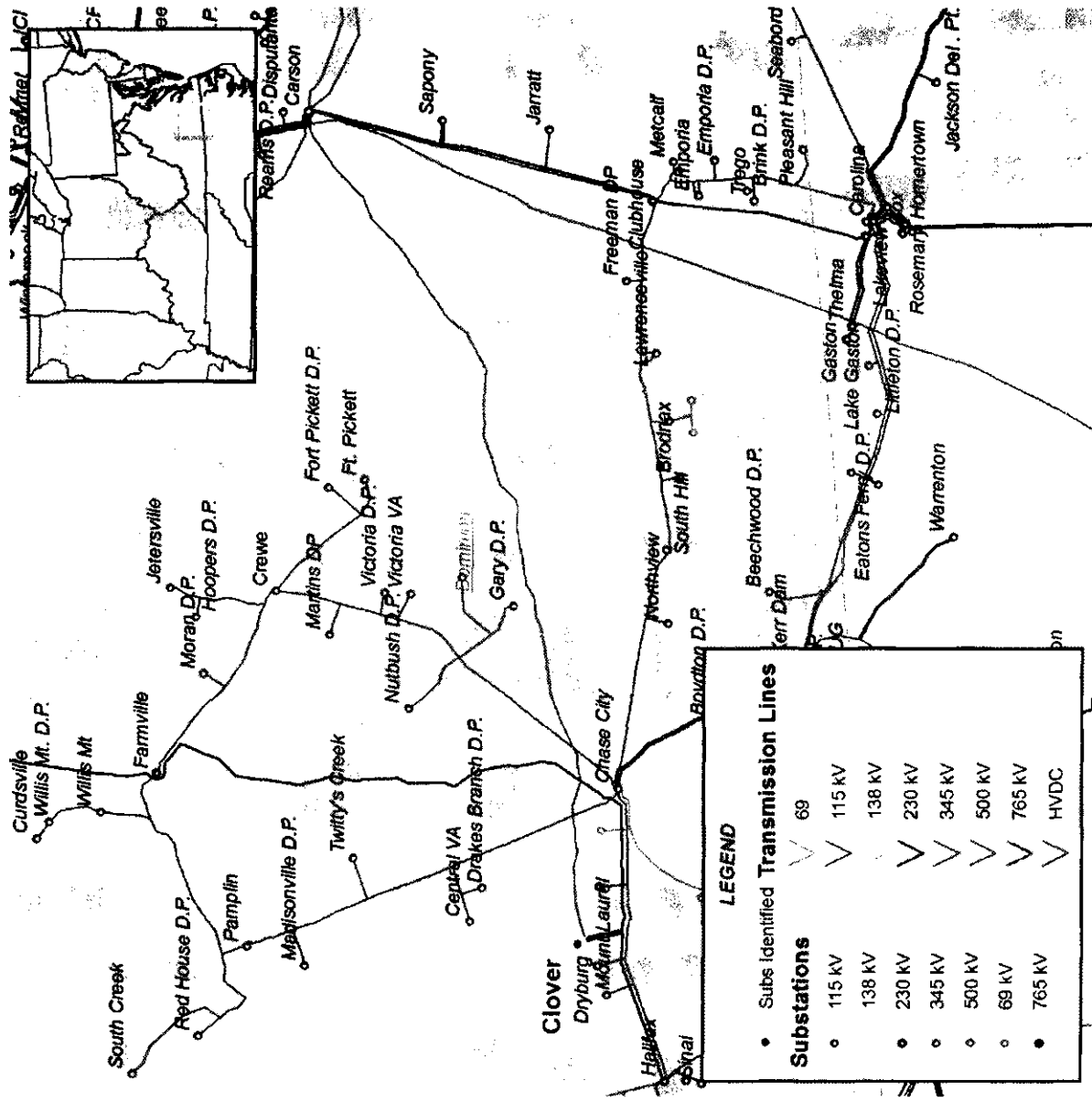
- **Domination Criteria – critical system condition of Surry #2 outage**
  - Yadkin – Chesapeake 115 kV is over its emergency rating for the loss of the Chesapeake 230/115 kV TX
  - The Yadkin 230/115 kV transformer is over its emergency rating for the loss of Yadkin – Chesapeake – Greenwich 230 kV
  - The Chesapeake 230/115 kV transformer is over its emergency rating for the loss of the Yadkin – Chesapeake – Greenwich 115 kV circuit or the Yadkin 230/115 kV TX #1
  - Each Yadkin 500/230 kV Transformer is overloaded for the loss of the parallel transformer
- **At Yadkin 500 kV, Install six 500 kV breakers and a third 500/230 kV TX at Yadkin**
- **Install a 2<sup>nd</sup> 230/115 kV TX at Yadkin**
- **Install a 2<sup>nd</sup> 230/115 kV TX at Chesapeake**
- **Uprate Yadkin – Chesapeake 115 kV**
- **Estimated Project Cost: \$45 M**
- **Projected in-service date: 6/1/2016**





## Additional Required Dominion Transmission Zone Upgrade

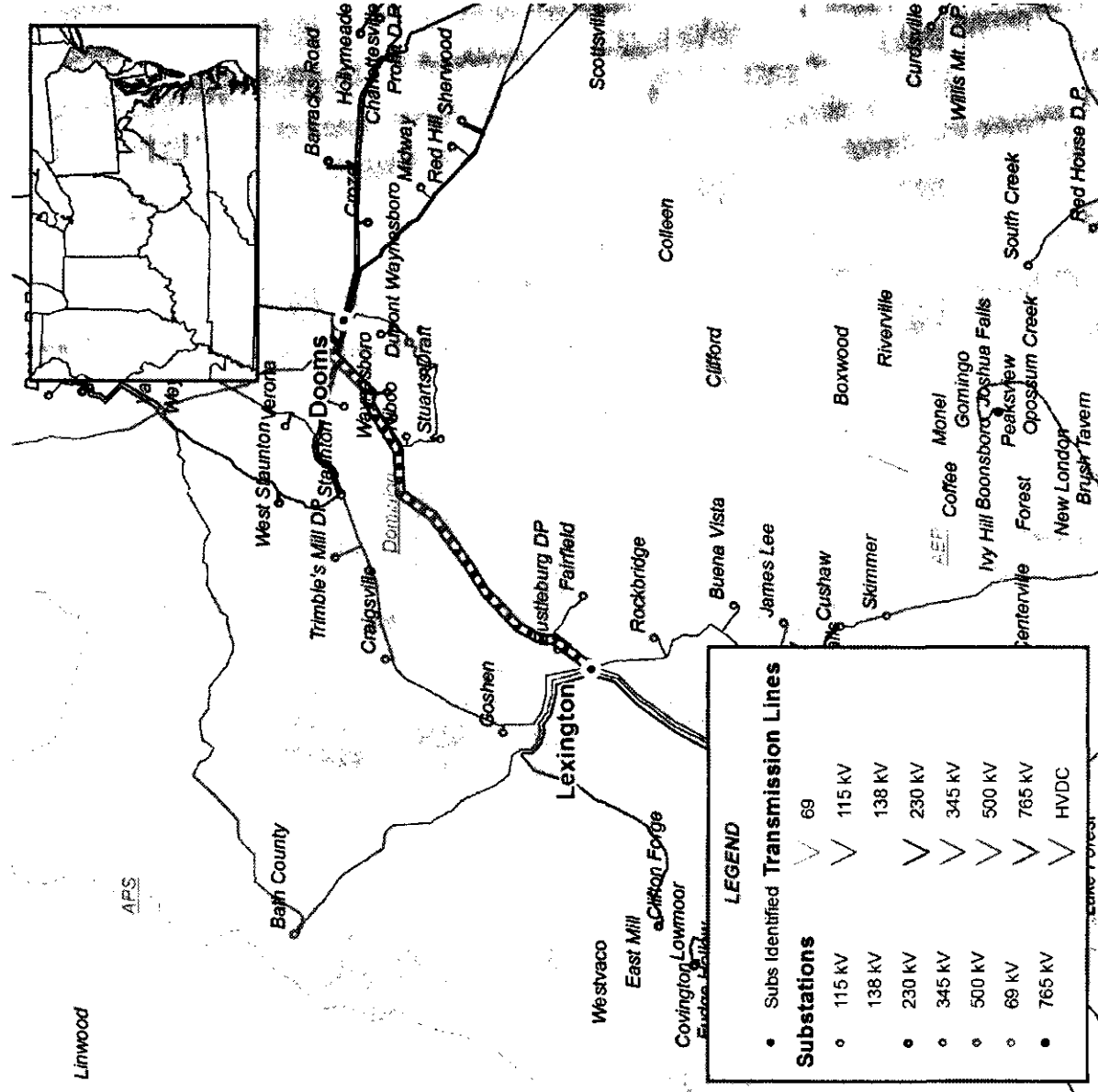
- Dominion Criteria – critical system conditions of Yorktown #3 or Surry #2 outage
- The loss of the Clover 500/230 TX #2 overloads Clover 500/230 kV TX #1
- Install a 3<sup>rd</sup> 500/230 kV TX at Clover
- Estimated Project Cost: \$16 M
- Projected in-service date: 6/1/2016





# Additional Required Dominion Transmission Zone Upgrade

- Dominion Criteria – critical system conditions of Yorktown #3 or Surry #2 outage
- The loss of Bath – Valley 500 kV overloads Doms – Lexington 500 kV
- Rebuild Lexington – Doms 500 kV – 40 miles
- Estimated Project Cost: \$120 M
- Projected in-service date: 6/1/2016



**Legend**

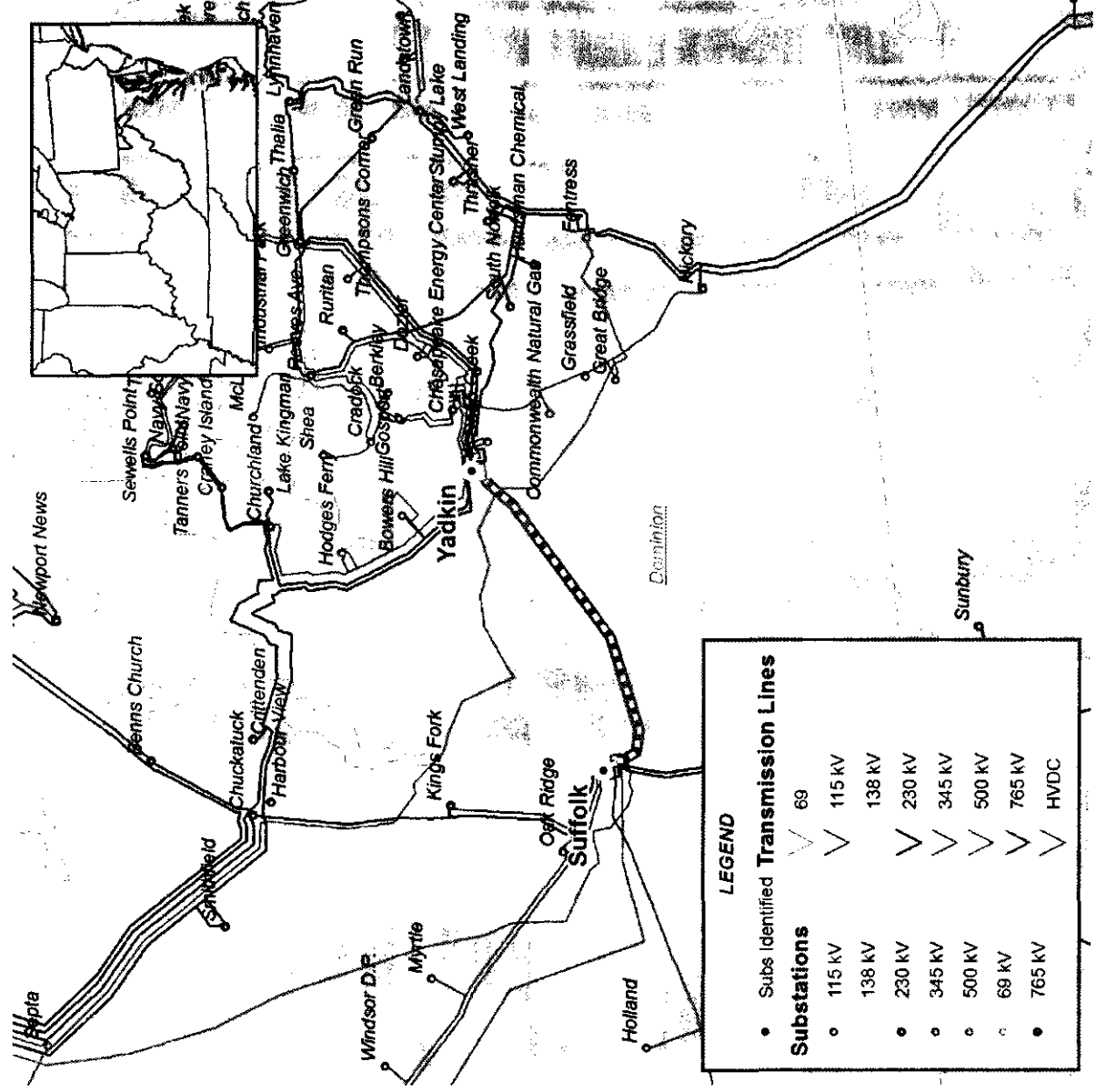
| Substations | Transmission Lines |
|-------------|--------------------|
| • 115 kV    | 69                 |
| • 138 kV    | 115 kV             |
| • 230 kV    | 138 kV             |
| • 345 kV    | 230 kV             |
| • 500 kV    | 345 kV             |
| • 69 kV     | 500 kV             |
| • 765 kV    | 69 kV              |
|             | 765 kV             |
|             | HVDC               |

- PJM TEAC  
04/27/2012



## Additional Required Dominion Transmission Zone Upgrade

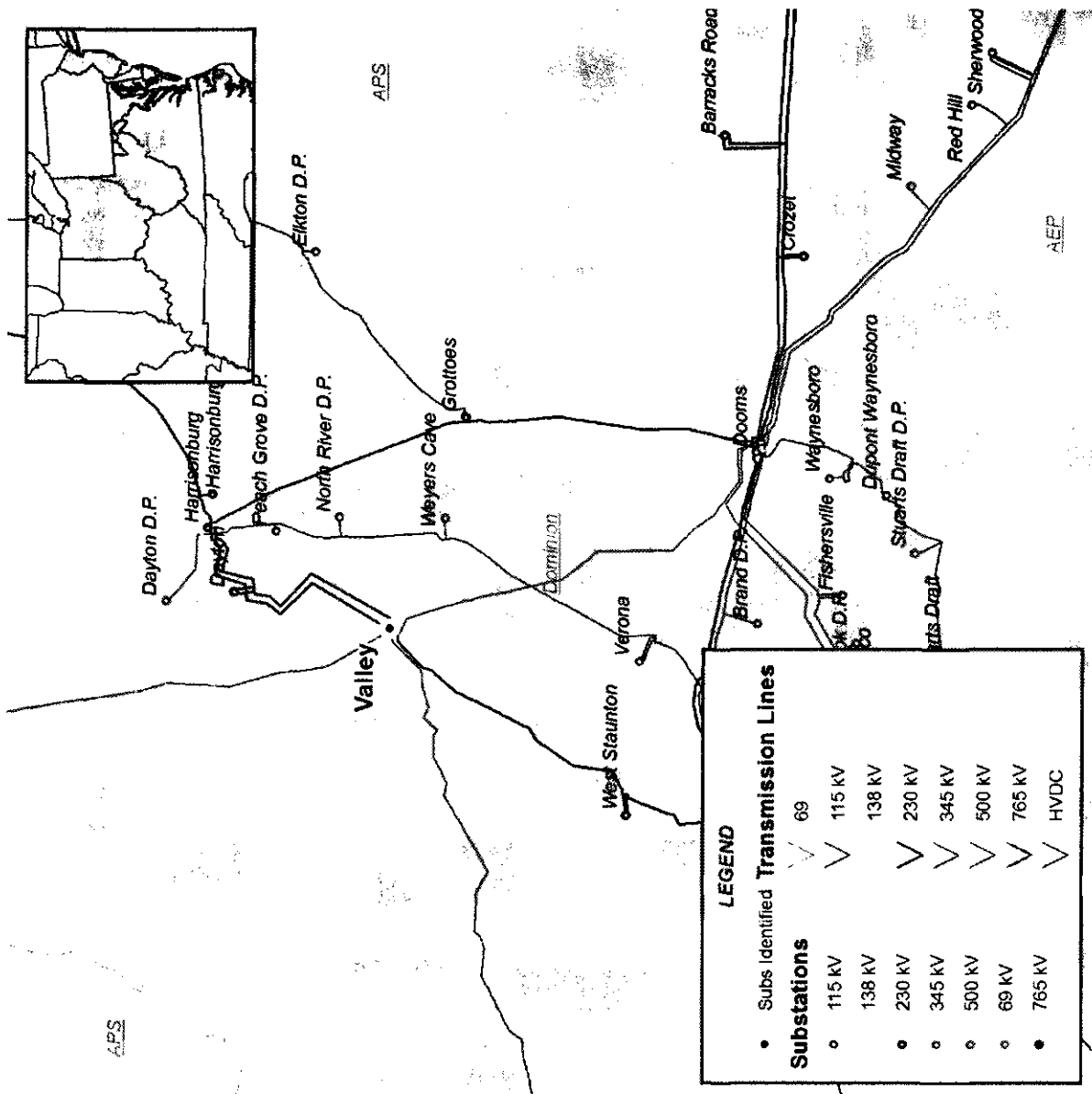
- N-1-1 Thermal Violation
- Huntsman – Thrasher 230 kV is over its emergency rating for the loss of the Suffolk – Yadkin 500 kV and Fentress – Septa 500 kV lines
- Build a Suffolk – Yadkin 230 kV line (14 miles)
  - Install two 230 kV breakers at both Suffolk and Yadkin Substation to interconnect
  - Primarily along existing towers
- Estimated Project Cost: \$40 M
- Projected in-service date: 6/1/2016





## Additional Required Dominion Transmission Zone Upgrade

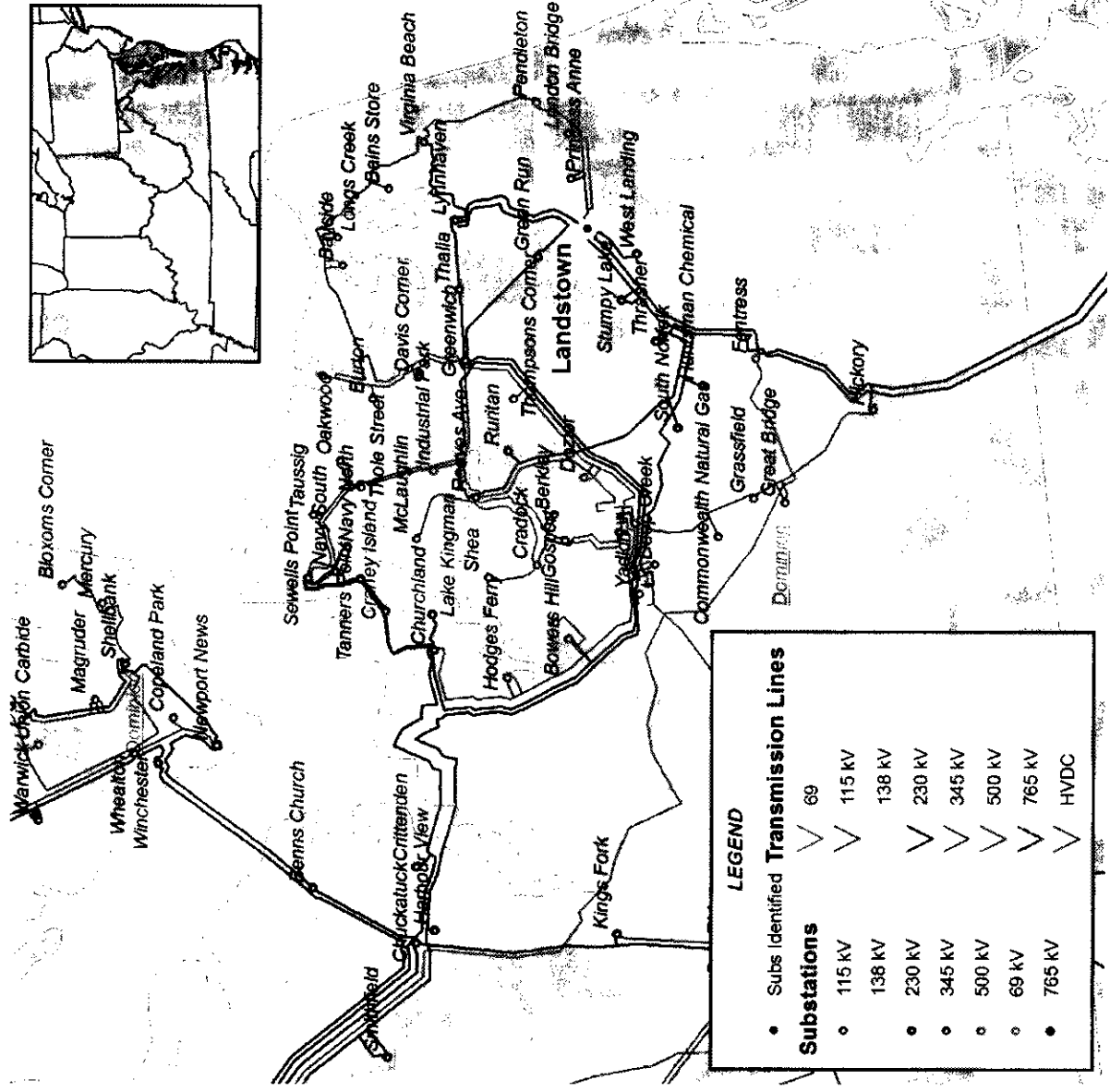
- N-1-1 Thermal Violation
- The Valley 500/230 kV TX is thermally overloaded for the loss of Dooms – Valley 500 kV and Dooms – Lexington 500 kV
- Add a second Valley 500/230 kV TX
- Estimated Project Cost: \$16 M
- Projected in-service date: 6/1/2016





## Additional Required Dominion Transmission Zone Upgrade

- N-1-1 Voltage Violation
- Voltage collapse in the VA Beach area for the loss of Suffolk – Yadkin 500 kV and Yadkin – Fentress 500 kV
- Install a 500 MVAR SVC at Landstown 230 kV
  - May need to split into two smaller SVCs
- Estimated Project Cost: \$60 M
- Projected in-service date: 6/1/2016



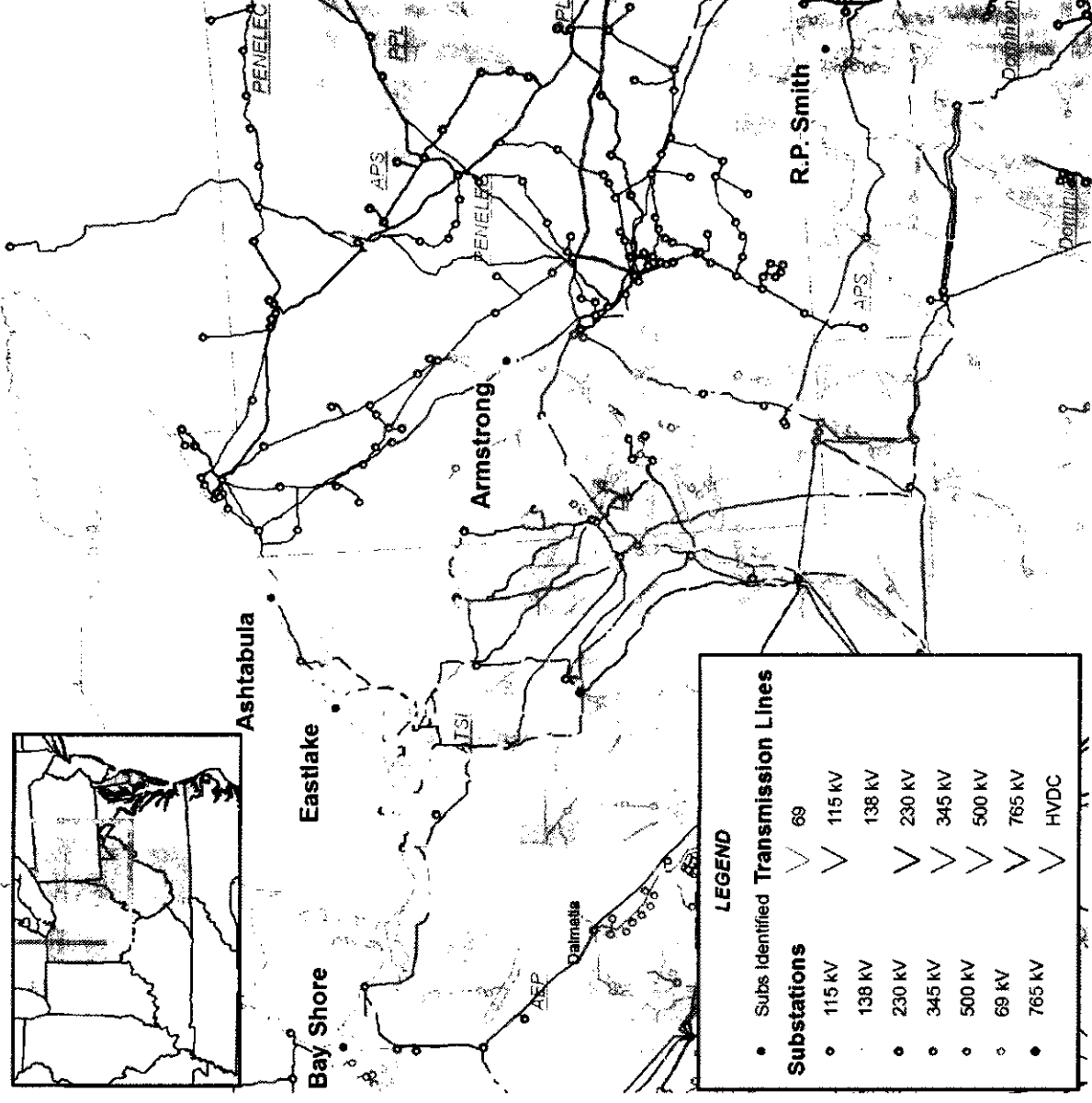
# FES Retirement Notifications



## ATSI/AP (FES) Deactivations – Status and Next Steps

Armstrong 1, & 2  
Ashtabula 5  
Bay Shore 2, 3, & 4  
Eastlake 1, 2, 3, 4, & 5  
Lake Shore 18  
R Paul Smith 3 & 4

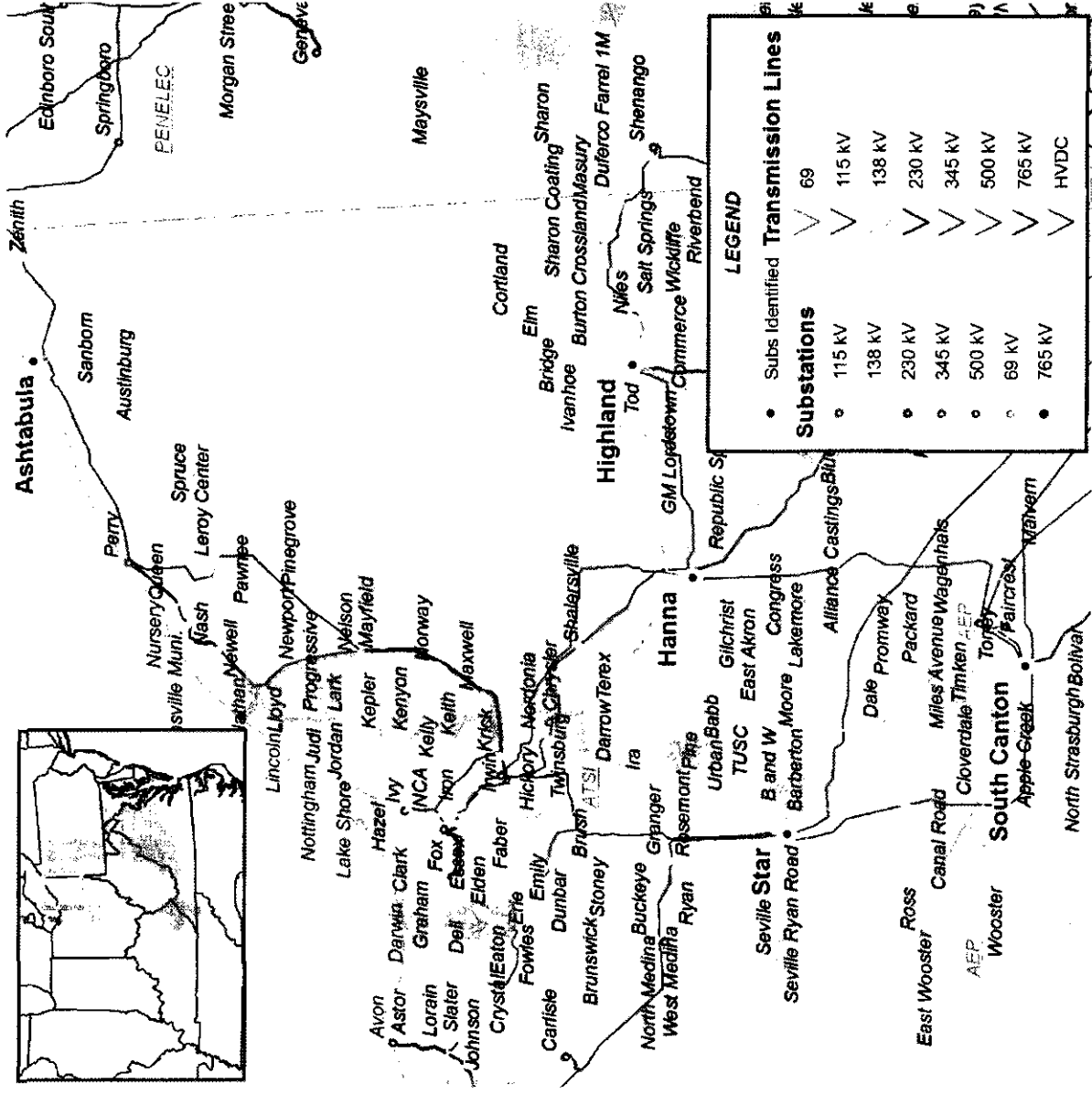
Requested deactivation  
date: 9/1/2012





# ATSI Transmission Zone Violations

- Criteria violations
  - N-1 Common Mode Voltage Study
  - N-1-1 Voltage
  - N-1-1 Thermal
  - Generation Deliverability
  - Load Deliverability
- Multiple 138kV bus voltage magnitude and voltage drop violations
- Multiple 138kV thermal violations
- Ashtabula 345/138kV transformer thermal violation
- Star 345/138kV transformer #1 thermal violation
- Hanna 345/138kV transformer thermal violation
- Highland – G689 345 kV line thermal violation
- South Canton - Star 345 kV line thermal violation (AEP-ATSI)





## Proposed Alternative Solution

- New single circuit 345kV in Ohio from Conesville to Star substations
- Proposed to relieve
  - Various N-1-1 Thermal and Voltage violations
  - Various Generation Deliverability violations
  - Load Deliverability violation (South Canton-Star 345kV)
- No specific route identified in order to evaluate ROW considerations



## Alternative Evolution

- (22) N-1-1 violations relieved
- (7) Generation Deliverability violations relieved
- South Canto-Star 345kV Load Deliverability violation not relieved
- (16) New Generation Deliverability violations created with addition of proposed solution
- (3) New N-1-1 violations created with addition of proposed solution
- Submitted project would need additional system reinforcement in order to address all constraints for FES deactivations



## Alternative Evolution Summary

- Proposed Solution does not relieve the need for any other proposed solutions needed to address violations
- Proposed Solution would be an additional project and not replace any previously identified solutions to address effects of FES retirements
- Given our evaluation PJM will not pursue this reinforcement as part of the required upgrades associated with the FES retirements



## Current status of 2013 assumptions

- Assumed RMR for 2013
  - Ashtabula 5, Eastlake 1, Eastlake 2, Eastlake 3, Lake Shore 18
- System Topology Assumption
  - **ATSI:**
    - Install a 50 MVAR capacitor bank at the Maclean 138 kV station. Projected in-service date is 6/1/2013.
    - Install a 345/138 kV transformer at the Inland Q-11 station. Projected in-service date is 6/1/2013.
    - Install a 138 kV circuit breaker at the Inland Q-11 station. Projected in-service date is 6/1/2013.
    - Upgrade terminal equipment on the Avon – Crestwood 138 kV line. Projected in-service date is 6/1/2013.
  - **AP:**
    - Replace breaker risers at Marlowe 138 kV and wave traps at Marlowe 138 kV and Bedington 138 kV to increase the rating on the Marlowe – Bedington 138 kV line #1 (PJM proposed baseline upgrade b1837)(new ratings will be 267/352 MVA SN/SE). The expected in-service date is 6/1/2013.
- Remaining violations identified may be mitigated by generation re-dispatch in real time with Operations monitoring all the identified contingencies, including the NERC Category 'C' contingencies.

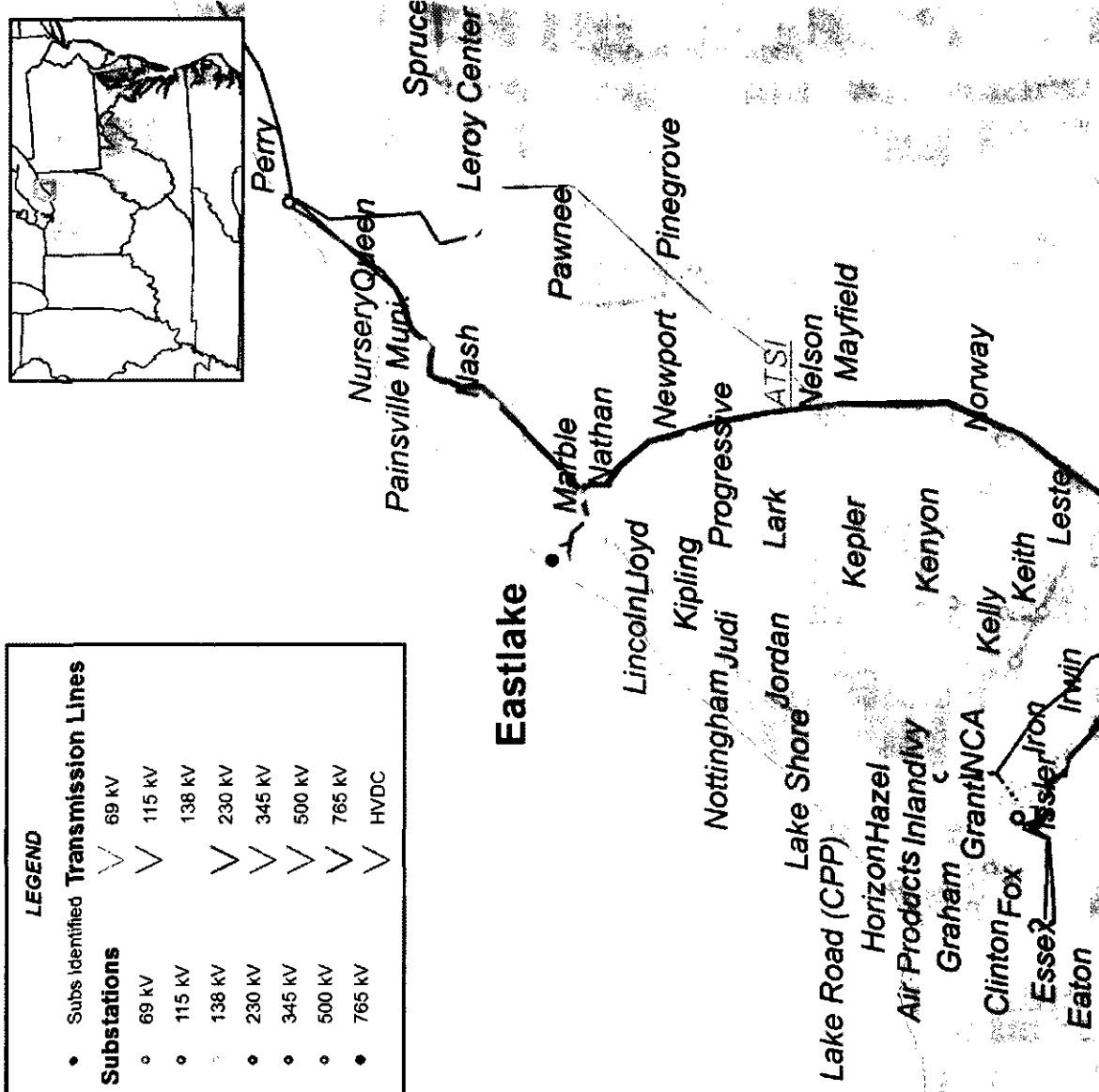


# ATSI/AP (FES) Deactivations – Assumptions

- ATSI Load Deliverability Voltage Sample Case would not converge and did not permit solving initial load flow to begin study without the following assumptions.
- Conversion of synchronous condensers needed to maintain an N-1 voltage-secure case.
- Most severe contingency: loss of Hanna – Juniper 345 kV line.

- Eastlake units 1-5 converted to synchronous condensers
- Eastlake unit 5 projected to be converted to a synchronous condenser by 6/1/2013.
- Eastlake unit 4 projected to be converted to synchronous condensers by 12/1/2013.
- Eastlake units 1, 2 and 3 projected to be converted to synchronous condensers by 6/1/2015

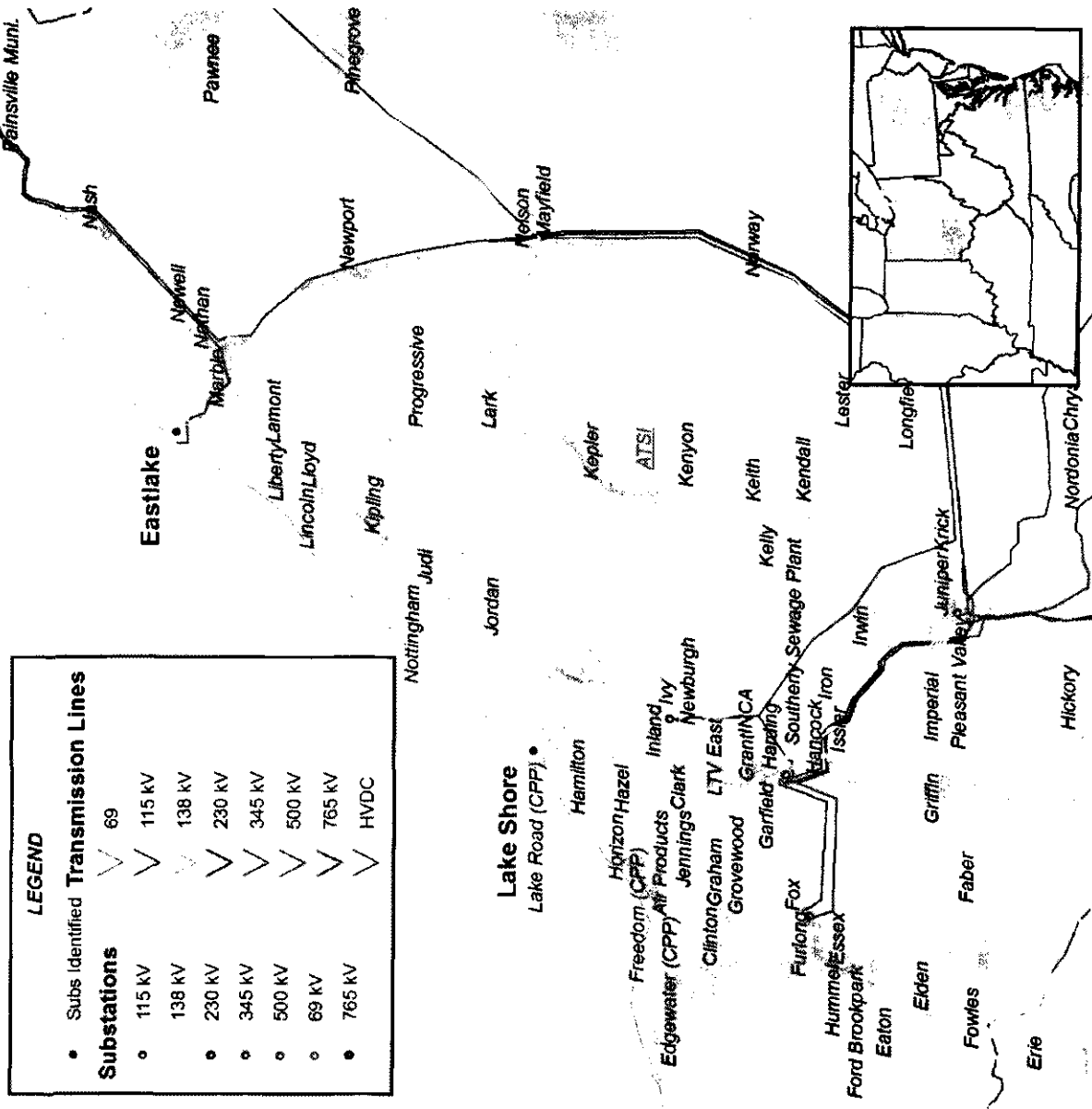
| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| • Substations     |                    |
| • 69 kV           | 69 kV              |
| • 115 kV          | 115 kV             |
| • 138 kV          | 138 kV             |
| • 230 kV          | 230 kV             |
| • 345 kV          | 345 kV             |
| • 500 kV          | 500 kV             |
| • 765 kV          | 765 kV             |
|                   | HVDC               |





## ATSI Transmission Zone Reinforcement

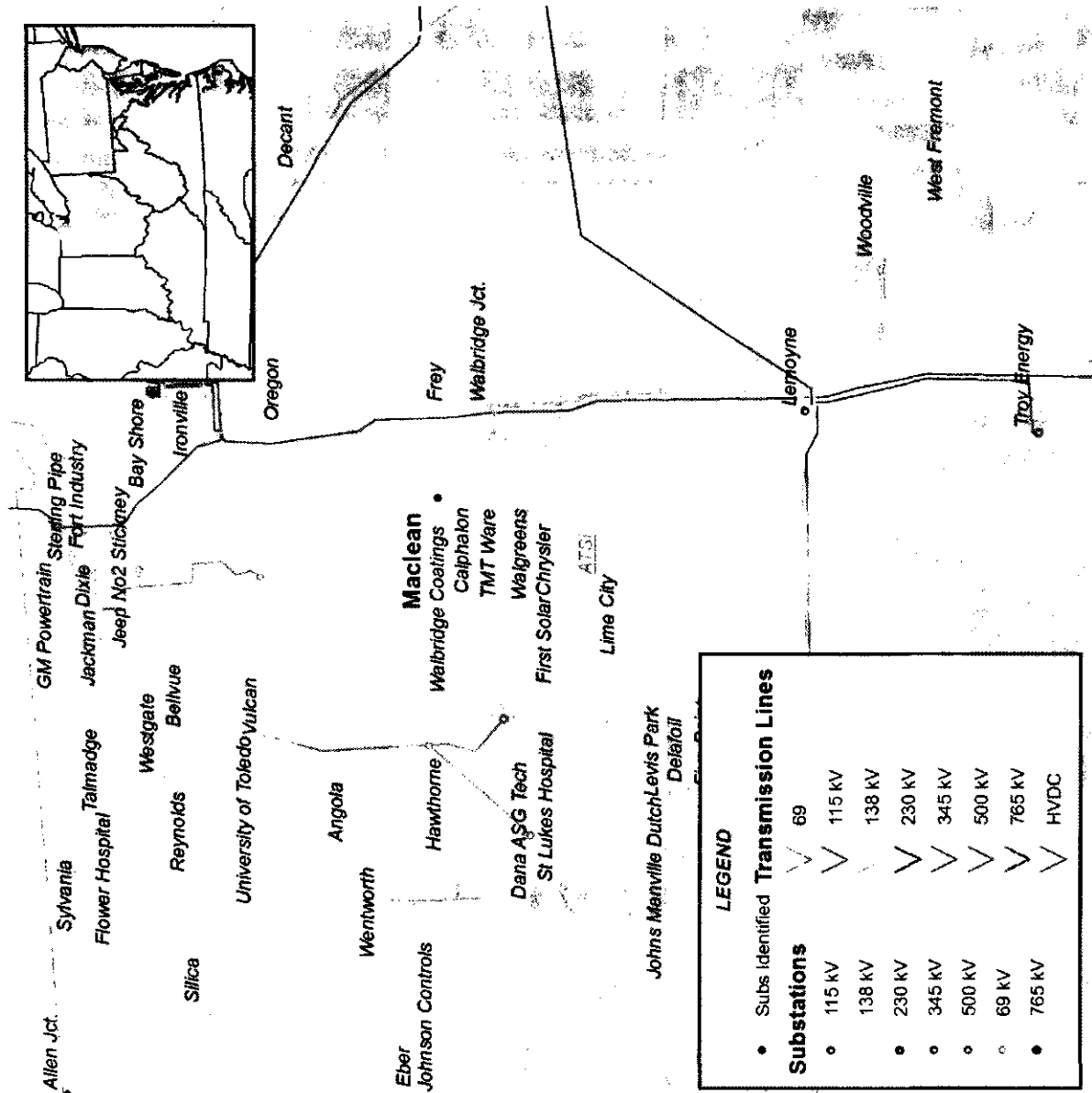
- Convert Eastlake units 1, 2, 3, 4 and 5, and Lakeshore unit 18 to a synchronous condenser
- Estimated Project Cost: \$120M
- Projected in-service date for Eastlake 5 is 6/1/2013
- Projected in-service date for Eastlake 4 is 12/1/2013
- Projected in-service date for Eastlake 1-3 is 6/1/2015
- Projected in-service date for Lakeshore 18 is 6/1/2015





# ATSI Transmission Zone Reinforcement

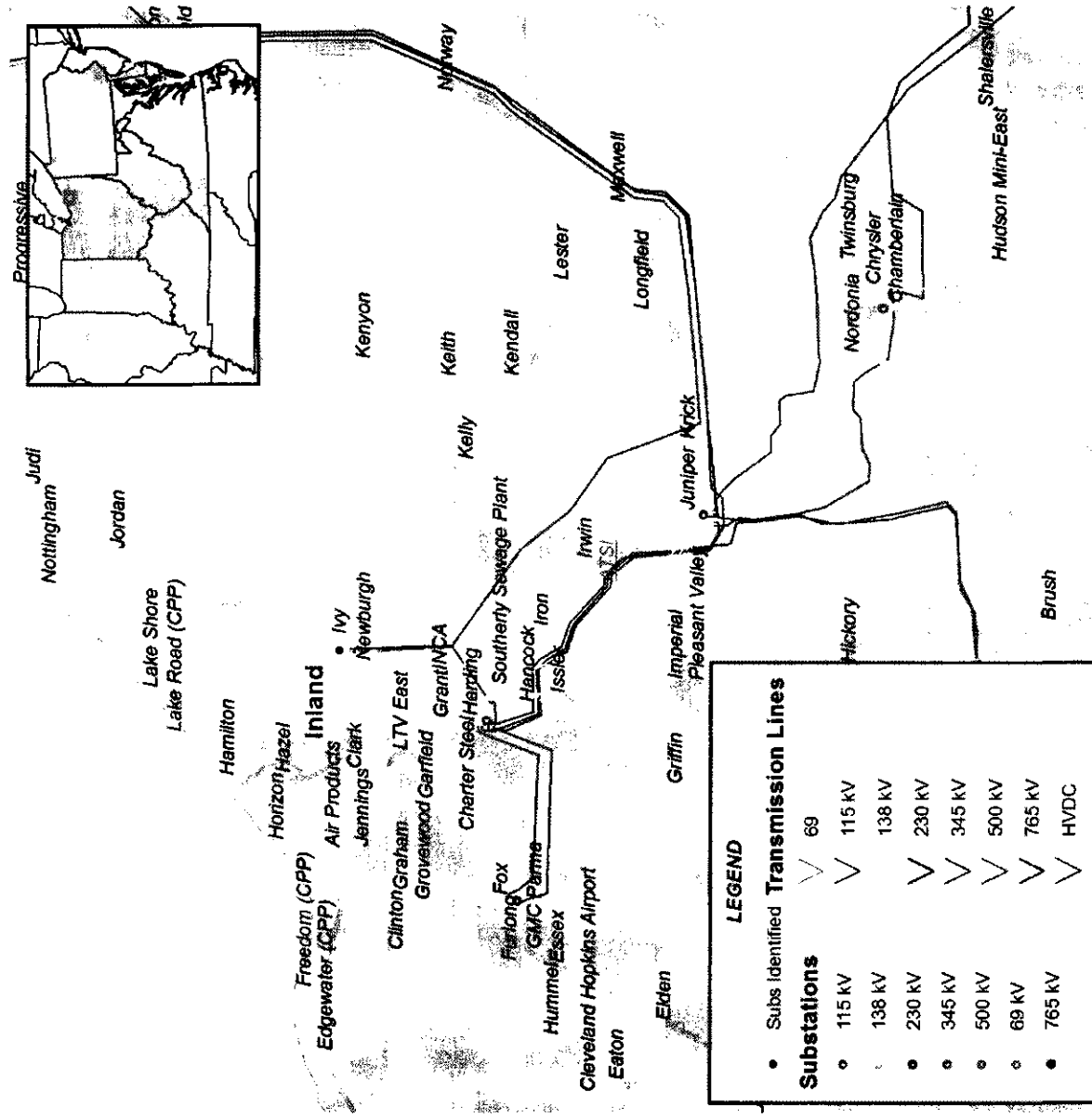
- N-1-1 Voltage Magnitude: (most severe) Lemoyne-Midway 345kV + Lemoyne-Maclean 138kV (91%)
- Install a 50 MVAR capacitor bank at the Maclean 138 kV station.
- Estimated Project Cost: \$3M
- Projected in-service date: 6/1/2013.





# ATSI Transmission Zone Reinforcement

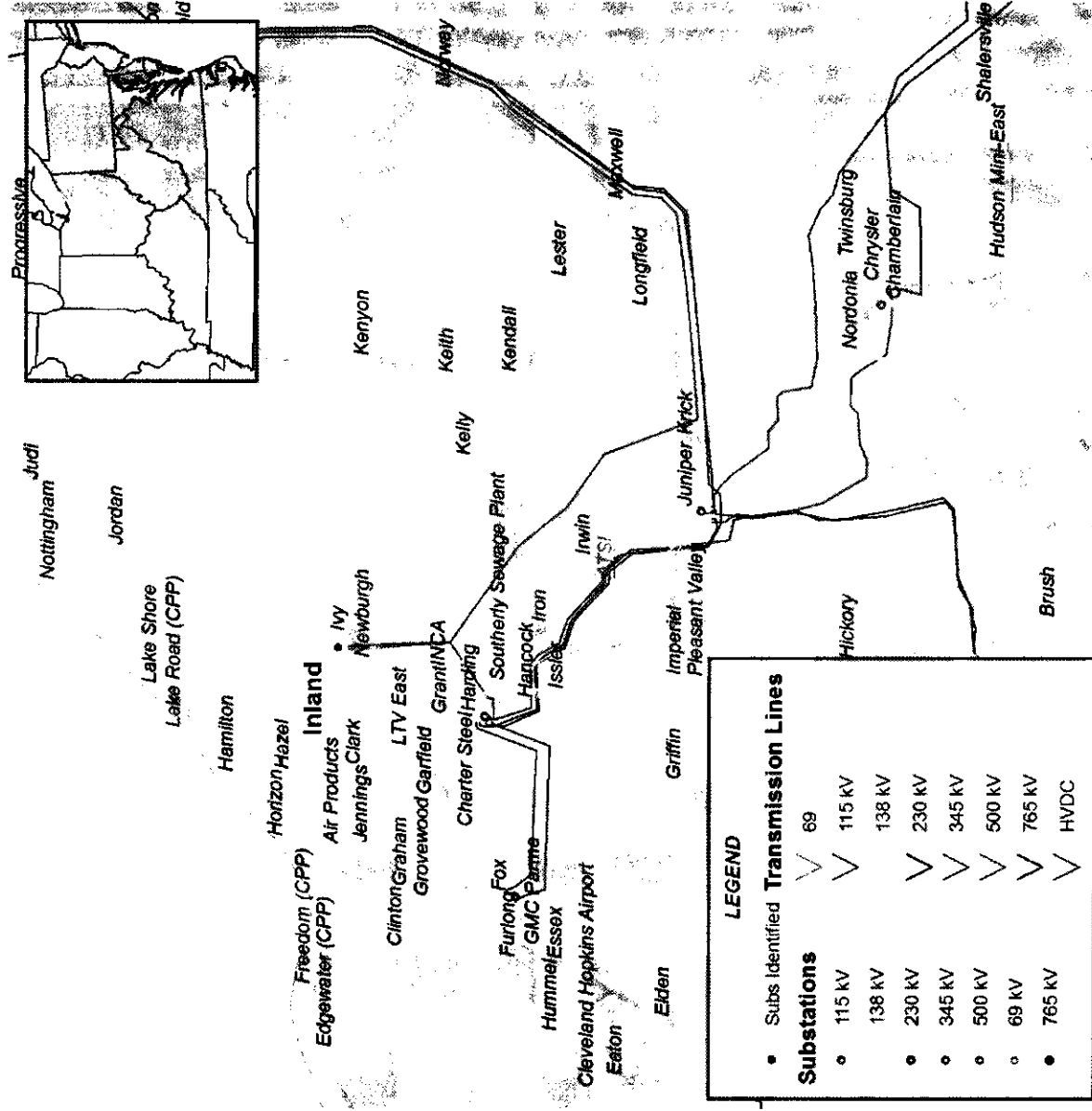
- Common Mode Outage Procedure: Eastlake 345kV breaker failure results in Ashtabula 345-138kV Transformer overload at 105%
- Install a 345/138 kV transformer at the Inland Q-11 station.
- Estimated Project Cost: \$7.2M
- Projected in-service date: 6/1/2013.





# ATSI Transmission Zone Reinforcement

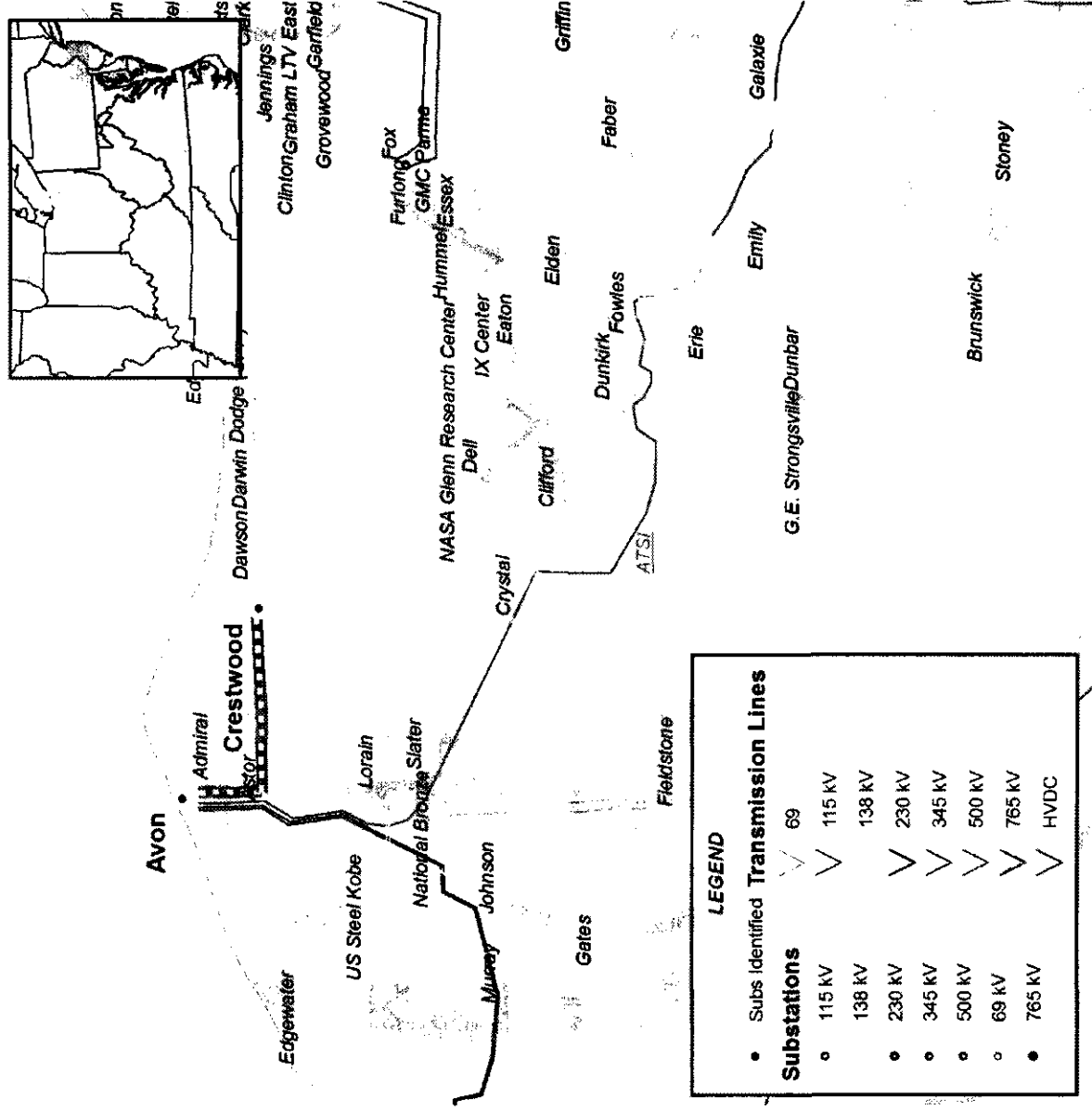
- Common Mode Outage Procedure:  
Inland-Ivy Q-11 138kV + Inland-Ivy Q-14 Common Tower Outage results in 116% overload on Clinton-Ridge Q-12 138kV
- Install a 138 kV circuit breaker at the Inland Q-11 station.
- Estimated Project Cost: \$0.9M
- Projected in-service date: 6/1/2013.





# ATSI Transmission Zone Reinforcement

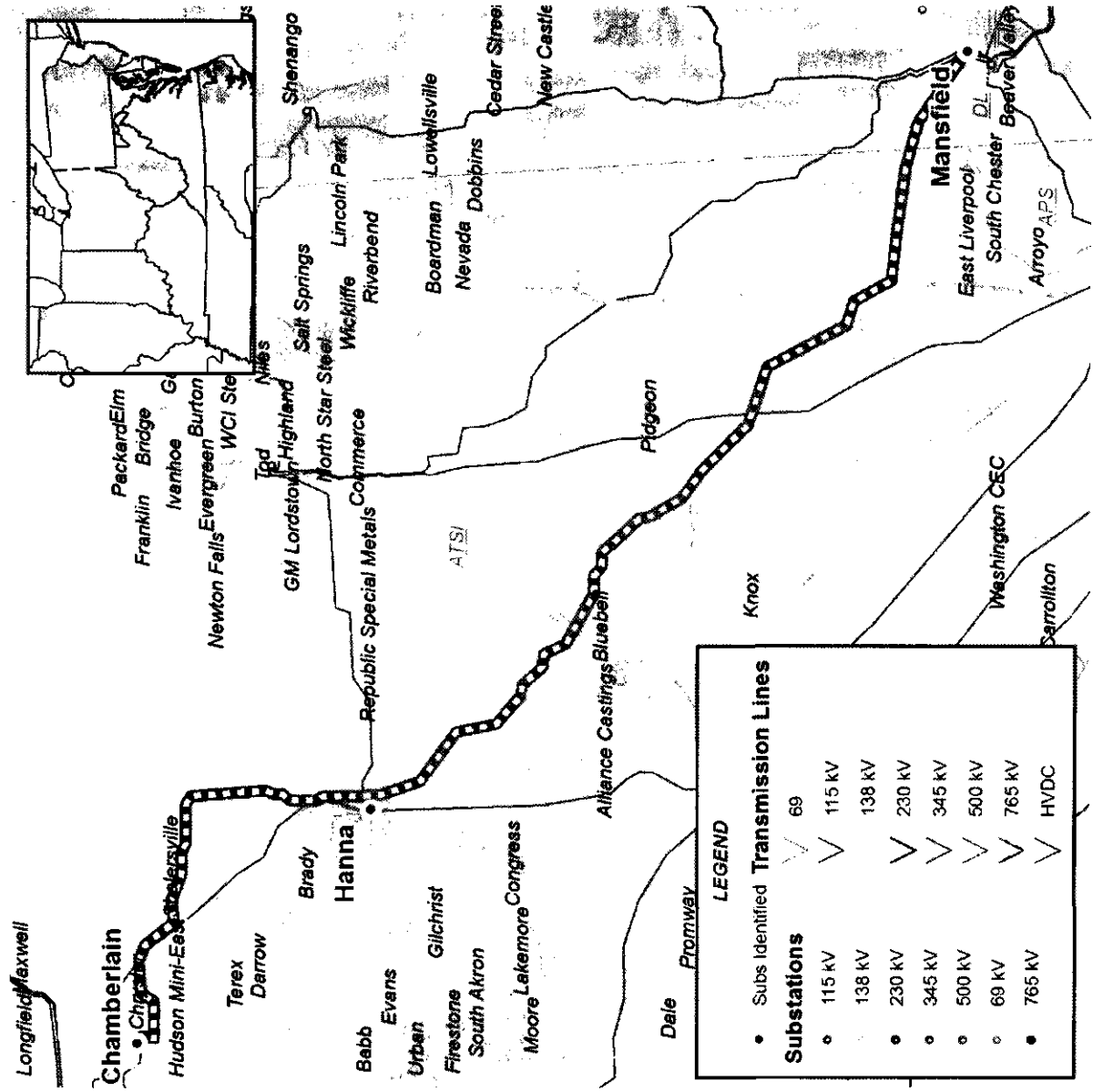
- Generator Deliverability:  
Avon-Fowles Q-2  
138kV + Avon-Fowles  
Q-3 138kV Common  
Tower Outage results in  
107% overload on  
Avon-Crestwood Q-1  
138kV line section
- Upgrade terminal  
equipment on the Avon  
– Crestwood 138 kV  
line.
- Estimated Project Cost:  
\$0.3M
- Projected in-service  
date: 6/1/2013.





# ATSI Transmission Zone Reinforcement

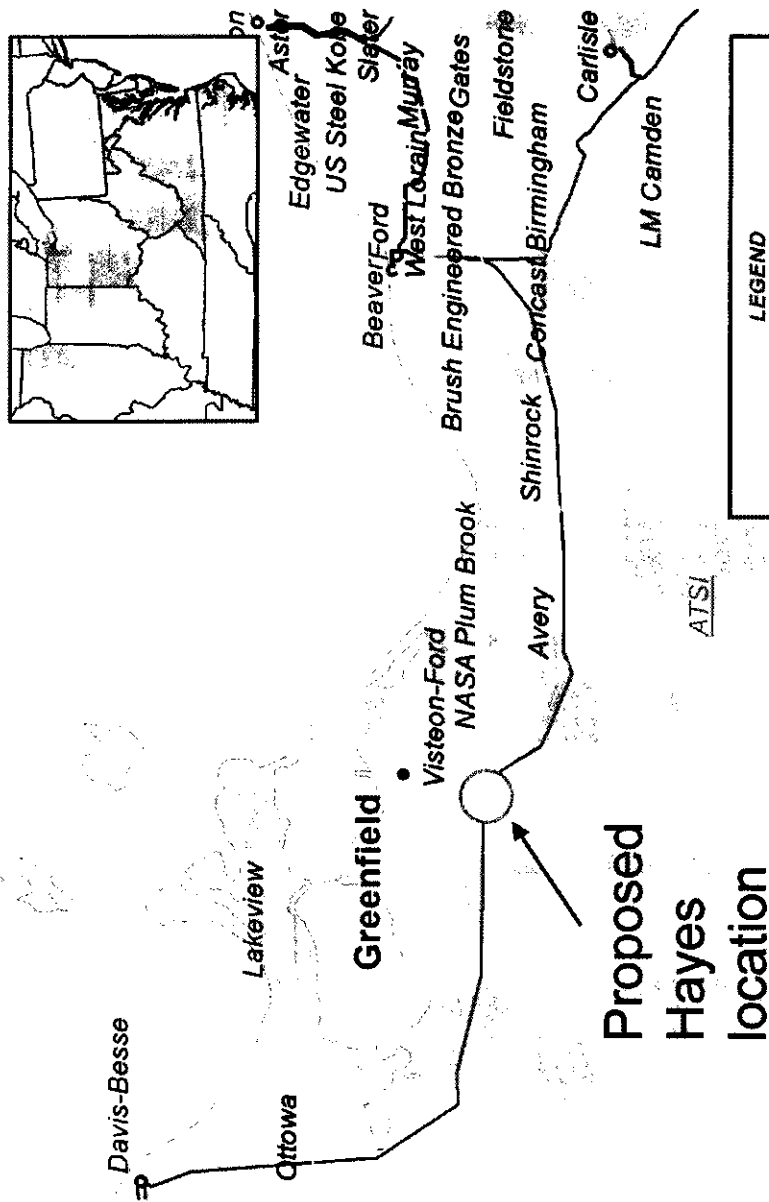
- Common Mode Outage Procedure: Hanna 345kV B106 breaker Failure results in 105% overload on Hanna 345-138kV TR #1
- Loop the Chamberlain - Mansfield 345 kV line into the Hanna 345 kV substation (existing base line upgrade b1283)
- Estimated Project Cost: \$8.1M
- Projected in-service date: 6/1/2014 (Advance from 6/1/2015)





## ATSI Transmission Zone Reinforcement

- Generator Deliverability:  
Loss of Beaver-Davis Besse 345kV results in 128% thermal overloads on Lakeview-Ottawa 138kV + Greefield-Lakeview 138kV lines
- Build new Hayes 345/138 kV substation with new 138 kV lines to: Greenfield #1, Greenfield #2, and Avery (existing baseline upgrade b1281)
- Cost estimate: \$24.5M
- Projected in-service date: 6/1/2014 (Advance from 6/1/2015)

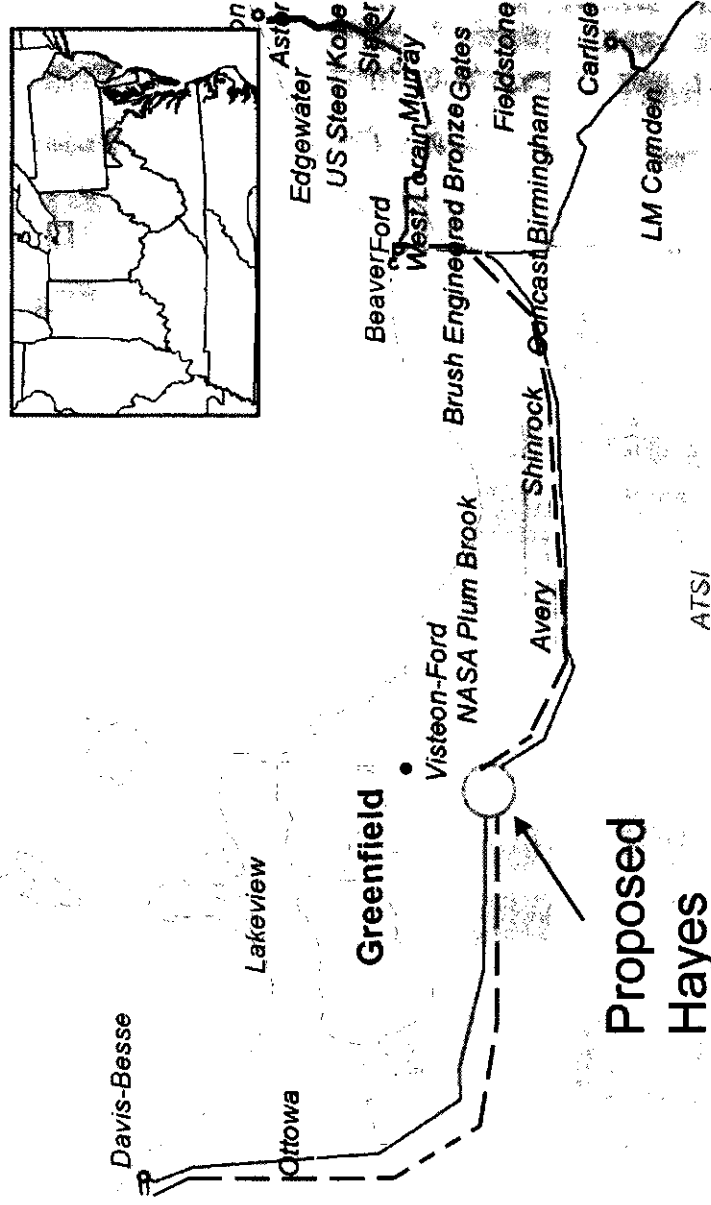


| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| • 69kV            | 69                 |
| • 115 kV          | 115 kV             |
| • 138 kV          | 138 kV             |
| • 230 kV          | 230 kV             |
| • 345 kV          | 345 kV             |
| • 500 kV          | 500 kV             |
| • 765 kV          | 765 kV             |
|                   | HVDC               |



# ATSI Transmission Zone Reinforcement

- Generator Deliverability:  
Loss of Beaver-Davis Besse 345kV results in 128% thermal overloads on Lakeview-Ottawa 138kV + Greefield-Lakeview 138kV lines
- Build Beaver - Hayes - Davis Besse #2 345 kV line (existing base line upgrade b1282)
- Estimated Project Cost: \$20.1
- Projected in-service date: 6/1/2014 (Advance from 6/1/2015)



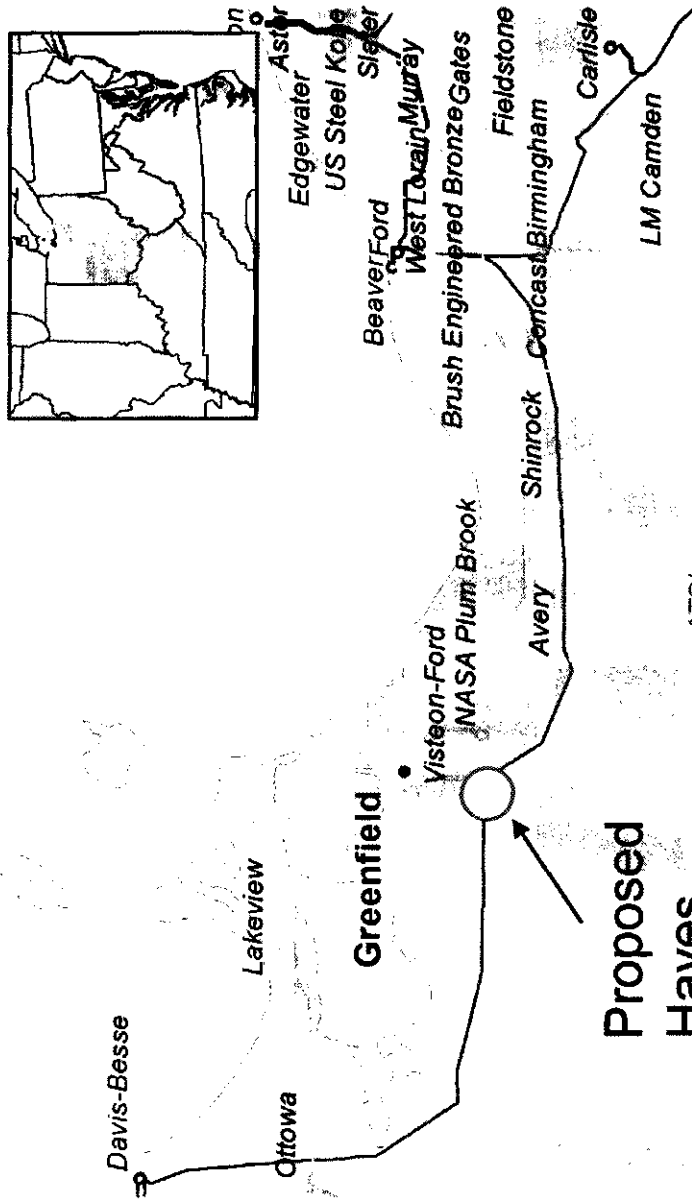
| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| Substations       | 69                 |
| • 69kV            | 115 kV             |
| • 115 kV          | 138 kV             |
| • 138 kV          | 230 kV             |
| • 230 kV          | 345 kV             |
| • 345 kV          | 500 kV             |
| • 500 kV          | 765 kV             |
| • 765 kV          | HVDC               |

ATSI



## ATSI Transmission Zone Reinforcement

- Addition to scope of Hayes 345-138kV Sub project due to N-1-1 LV 90% for loss of Hayes 345-138kV TR + Ottawa-Lakeview 138kV
- Install a 50 MVAR capacitor at Hayes 138 kV.
- Estimated Project Cost: \$1.5M
- Projected in-service date: 6/1/2015.



| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| • 69kV            | 69                 |
| • 115 kV          | 115 kV             |
| • 138 kV          | 138 kV             |
| • 230 kV          | 230 kV             |
| • 345 kV          | 345 kV             |
| • 500 kV          | 500 kV             |
| • 765 kV          | 765 kV             |
| • HVDC            | HVDC               |

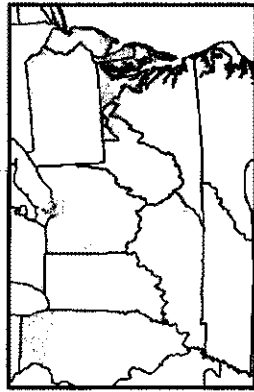
AEP

ATSI



# ATSI Transmission Zone Reinforcement

- Needed in conjunction with Hayes 345-138kV Sub project due to Common Mode outage (Greenfield 138kV Bus) 135% OL on Avery 138-69kV
- Install a 138/69 kV transformer at the Avery station.
- Estimated Project Cost: \$3.2M
- Projected in-service date: 6/1/2015.



New Departure Greenfield  
Visteon-Ford

NASA Plum Brook

Avery

Shinrock

Edgcast Birmingham

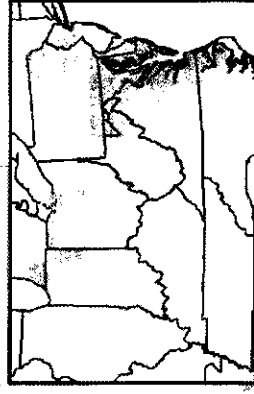
ATSI

| LEGEND             |                    |
|--------------------|--------------------|
| • Subs Identified  | Transmission Lines |
| <b>Substations</b> |                    |
| • 115 kV           | 69                 |
| • 138 kV           | 115 kV             |
| • 230 kV           | 138 kV             |
| • 345 kV           | 230 kV             |
| • 500 kV           | 345 kV             |
| • 69 kV            | 500 kV             |
| • 765 kV           | 765 kV             |
|                    | HVDC               |



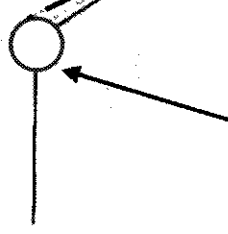
# ATSI Transmission Zone Reinforcement

- Needed in conjunction with Hayes 345-138kV Sub project due to Common Mode outage (Greenfield 138kV Bus) 105% overload on Avery-Hayes 138kV
- Increase design temperature limitation on the Avery – Hayes 138 kV line by raising the existing structures. New ratings will be 224/282 MVA (SN/SE)
- Estimated Project Cost: \$0.13M
- Projected in-service date: 6/1/2015



New Departure Greenfield  
Visteon-Ford

NASA Plum Brook



Proposed  
Hayes  
location

Shinrock

East Birmingham

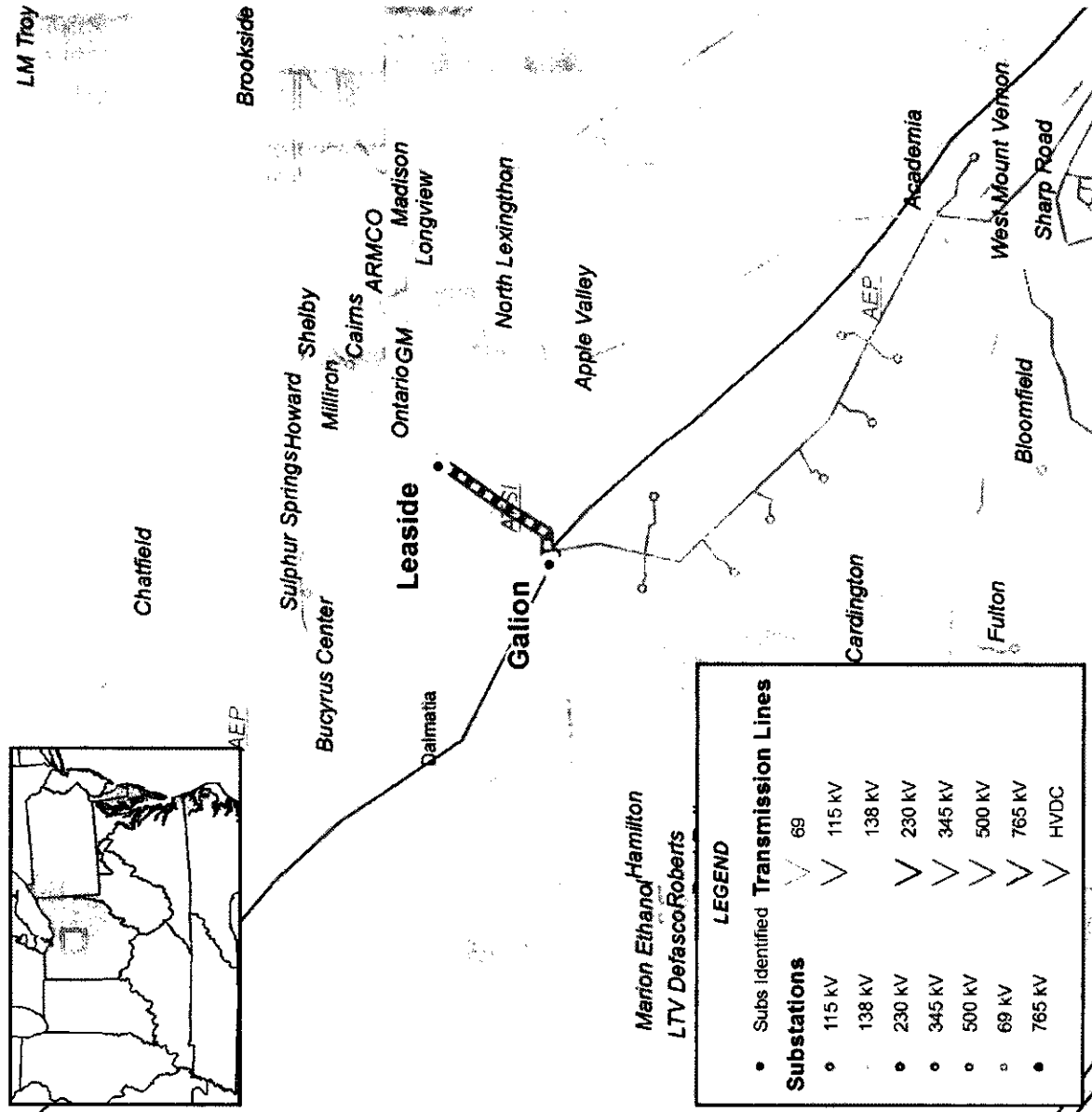
ATSI

| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| Substations       | 69                 |
| • 115 kV          | 115 kV             |
| • 138 kV          | 138 kV             |
| • 230 kV          | 230 kV             |
| • 345 kV          | 345 kV             |
| • 500 kV          | 500 kV             |
| • 69 kV           | 765 kV             |
| • 765 kV          | HVDC               |



# ATSI Transmission Zone Reinforcement

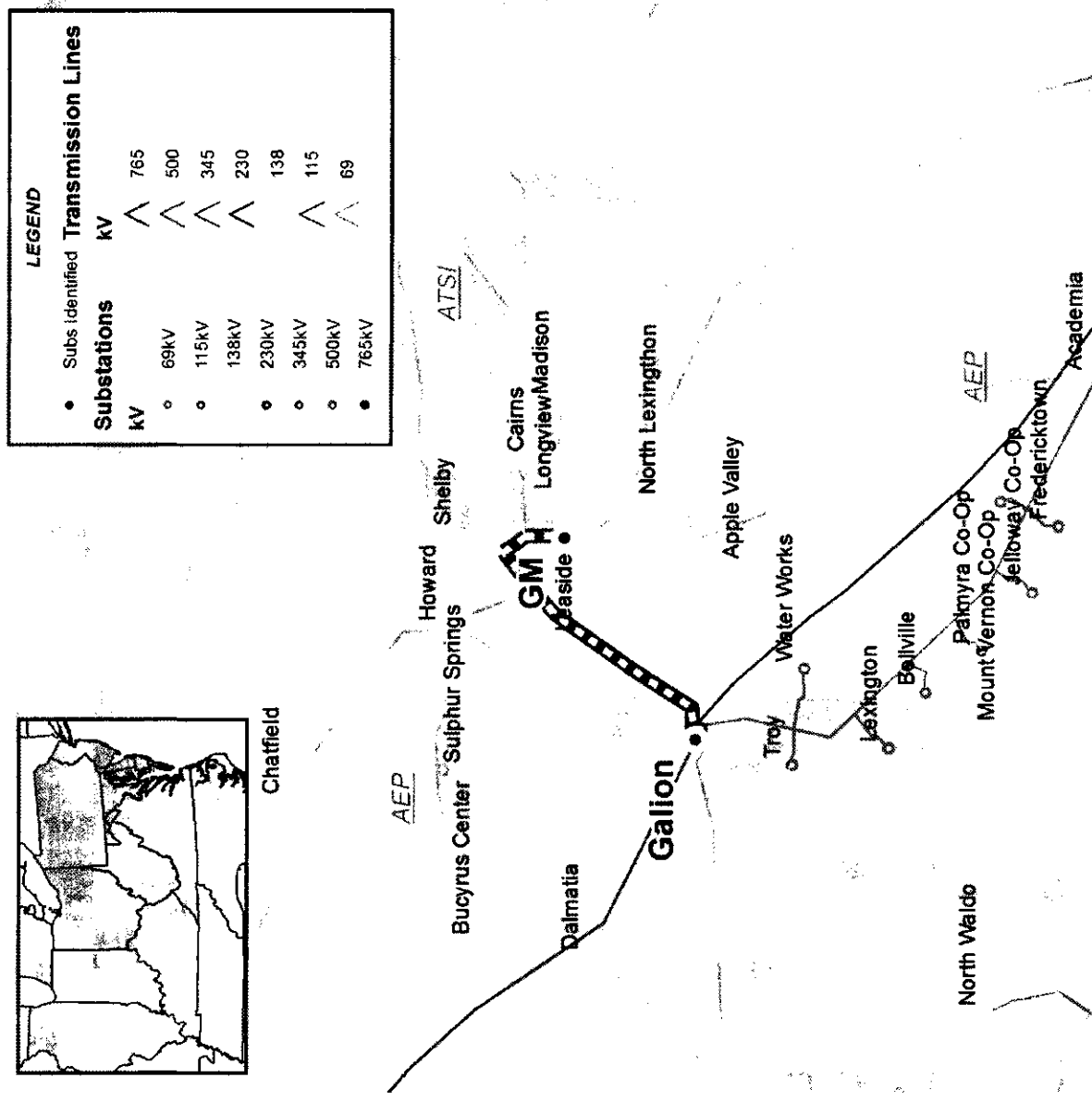
- Common Mode Outage Procedure: Galion 138kV breaker 54 Failure results in 111% overload on Galion-Leaside 138kV
- Re-conductor the Galion – Leaside 138 kV line with 336 ACSS.
- Estimated Project Cost: \$4.9M
- Projected in-service date: 6/1/2014.





## ATSI Transmission Zone Reinforcement

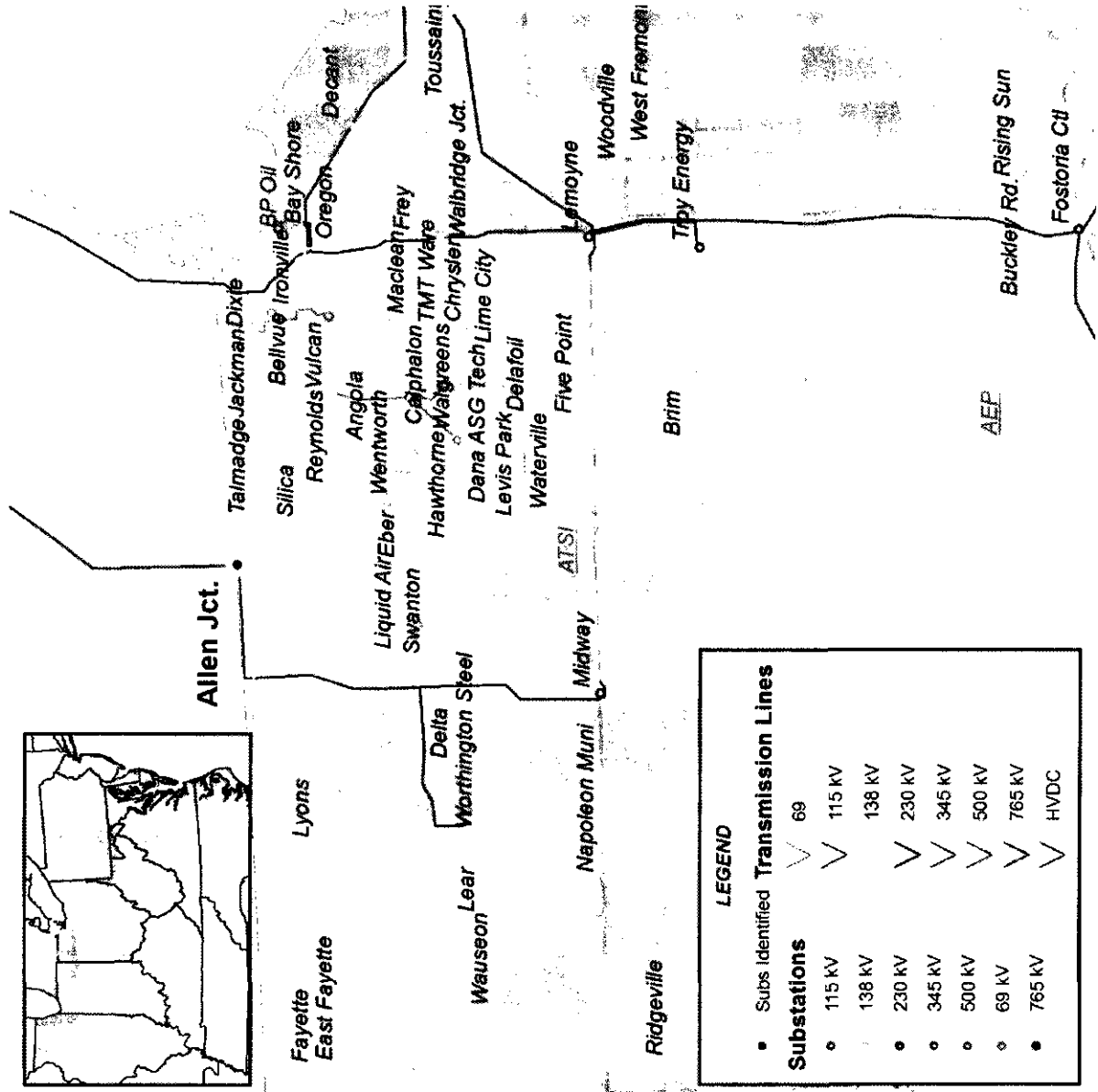
- Generator Deliverability:  
Brookside-Howard 138kV +  
Brookside-Leaside 138kV  
Common Tower Outage  
results in 107% overload  
on Galion-GM-Ontario-  
Cairns 138kV line sections
- Re-conductor the Galion –  
GM Mansfield – Ontario -  
Cairns 138 kV line with 477  
ACSS.
- Estimated Project Cost:  
\$9.8M
- Projected in-service date:  
6/1/2014.





# ATSI Transmission Zone Reinforcement

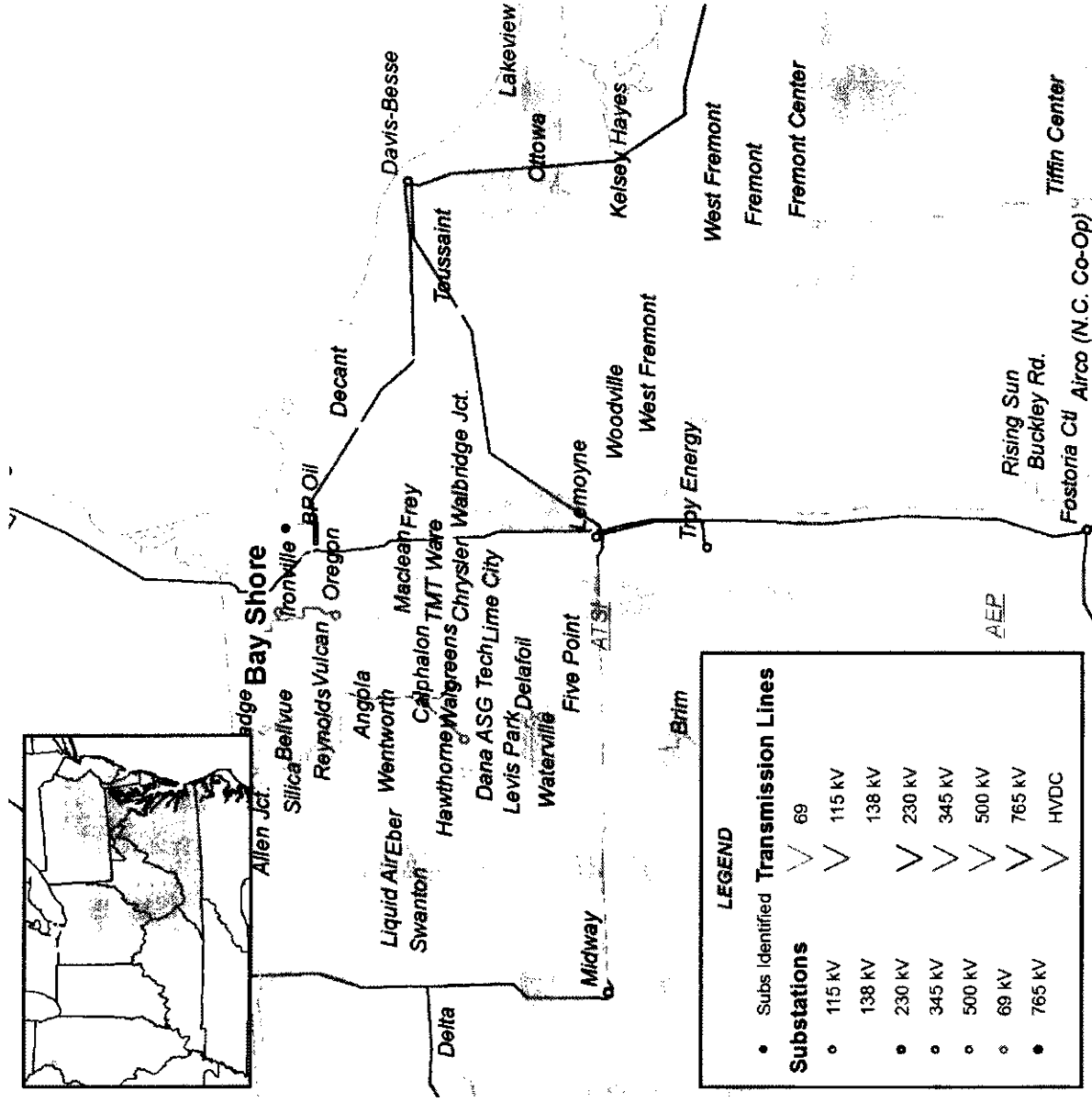
- N-1-1 Thermal: Loss of Allen Junction 345-138kV TR + Bayshore 345-138kV TR results in 110% OL on Eber-Liquid Air 138kV line section
- Install a 2<sup>nd</sup> 345/138 kV transformer at the Allen Junction station.
- Estimated Project Cost: \$7.2M
- Projected in-service date: 6/1/2014.





# ATSI Transmission Zone Reinforcement

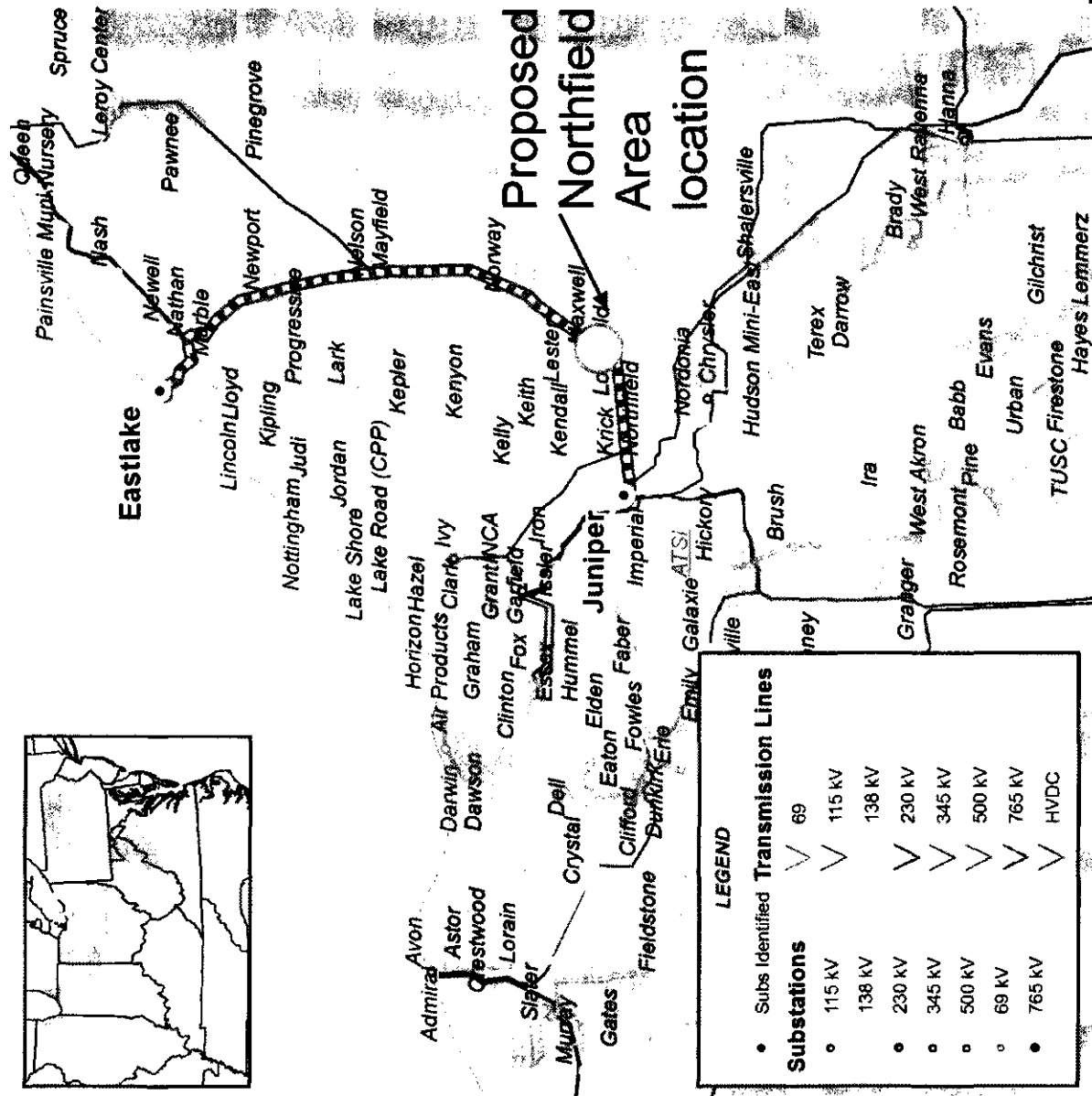
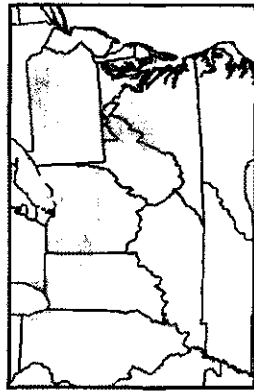
- N-1-1 Voltage Magnitude: Bayshore 345-138kV Transformer + Lemoyne-Maclean 138kV results in low voltage (90%) at Maclean
- Install a 2<sup>nd</sup> 345/138 kV transformer at the Bayshore station.
- Estimated Project Cost: \$7.2M
- Projected in-service date: 6/1/2014.





# ATSI Transmission Zone Reinforcement

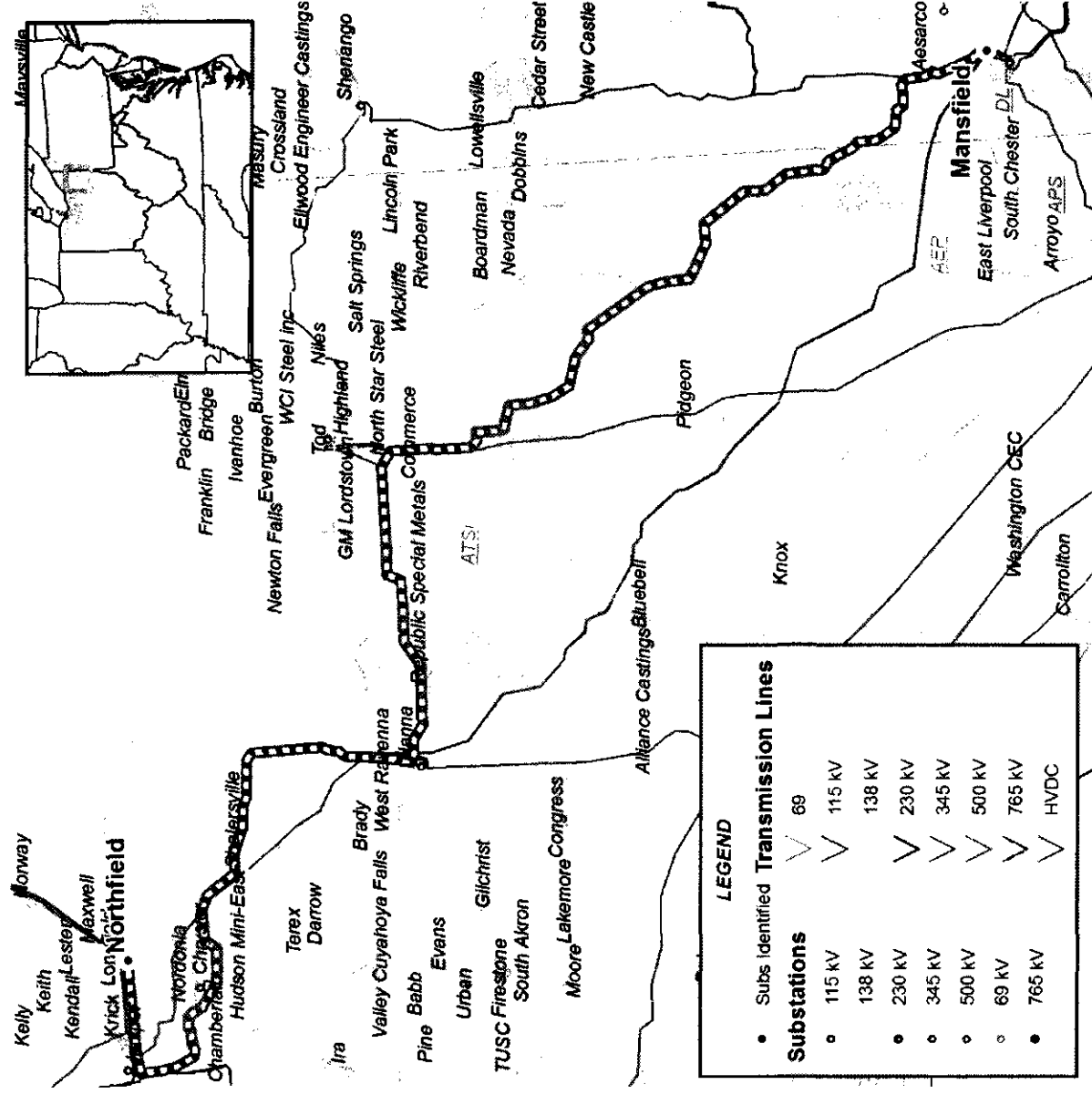
- FE voltage stability criteria violation.
- Create a new Northfield Area 345 kV switching station by looping in the Eastlake – Juniper 345 kV line and the Perry - Inland 345 kV line.
- Estimated Project Cost: \$37.5M
- Projected in-service date: 6/1/2015.





# ATSI Transmission Zone Reinforcement

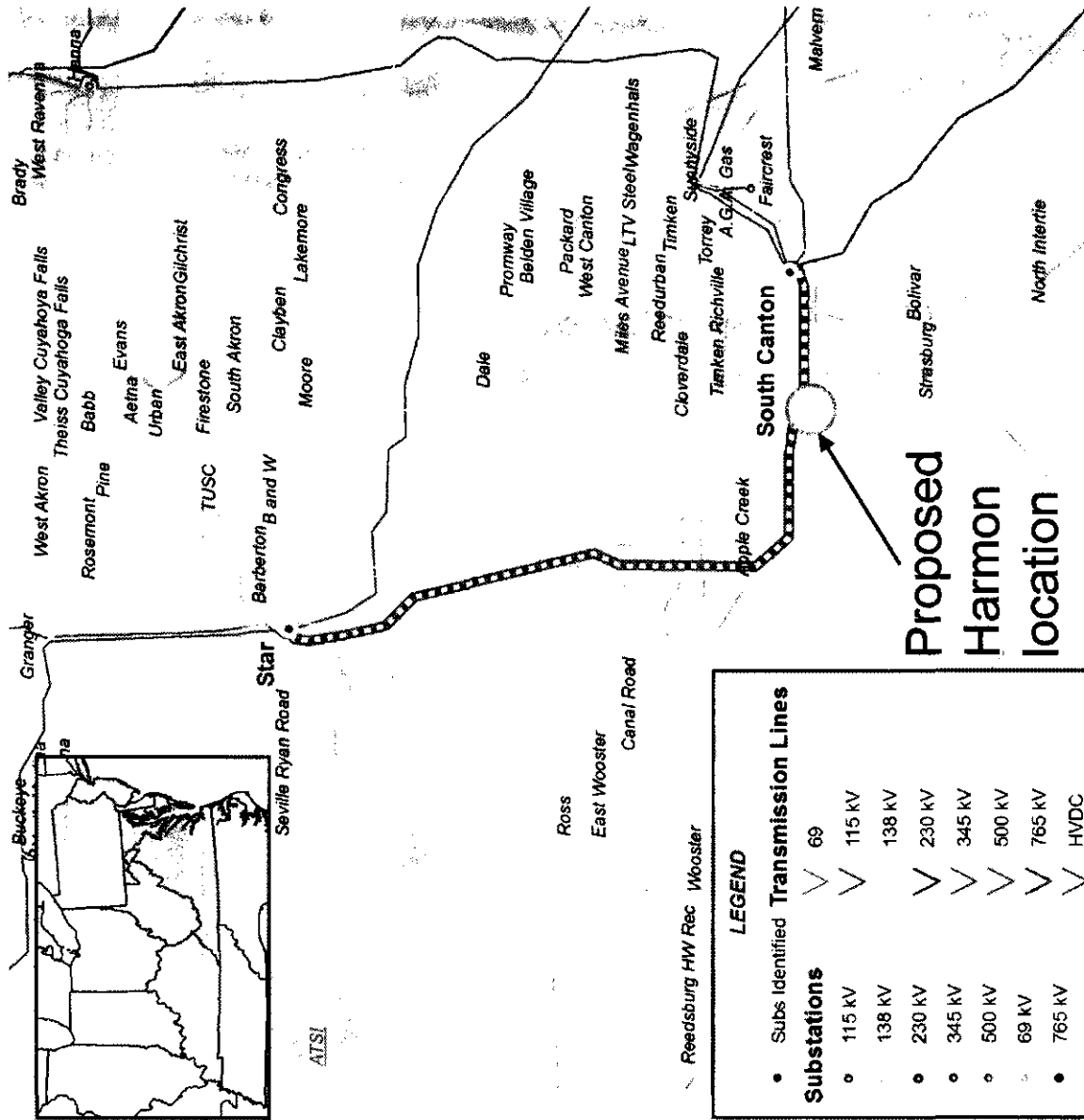
- FE voltage stability criteria violation.
- Build a new Mansfield - Northfield Area 345 kV line.
- Estimated Project Cost: \$184.5M
- Projected in-service date: 6/1/2015.





# ATSI Transmission Zone Reinforcement

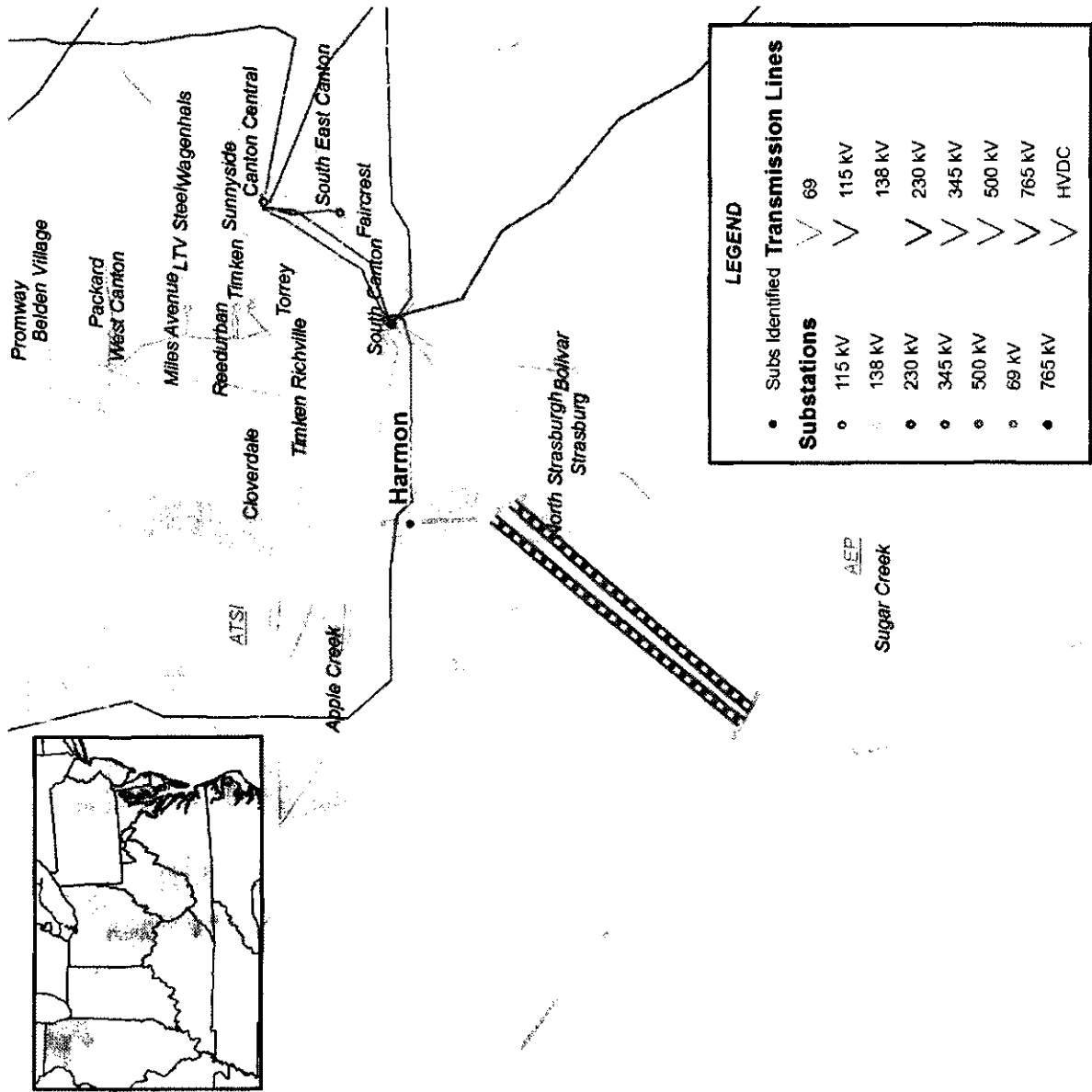
- Common Mode Outage Procedure: Star 345kV B-12 breaker Failure, Star B-8 138kV breaker Failure, Barberton-Star 138kV + Cloverdale-Star 138kV TWL, results in thermal overloads on Star 345-138kV TR #1 101%, Star-Barberton #1 106%, and Star-Barberton #2 103%
- Create a new Harmon 345/138/69 kV substation by looping in the Star – South Canton 345 kV line.
- Estimated Project Cost: \$46M
- Projected in-service date: 6/1/2015.





# ATSI Transmission Zone Reinforcement

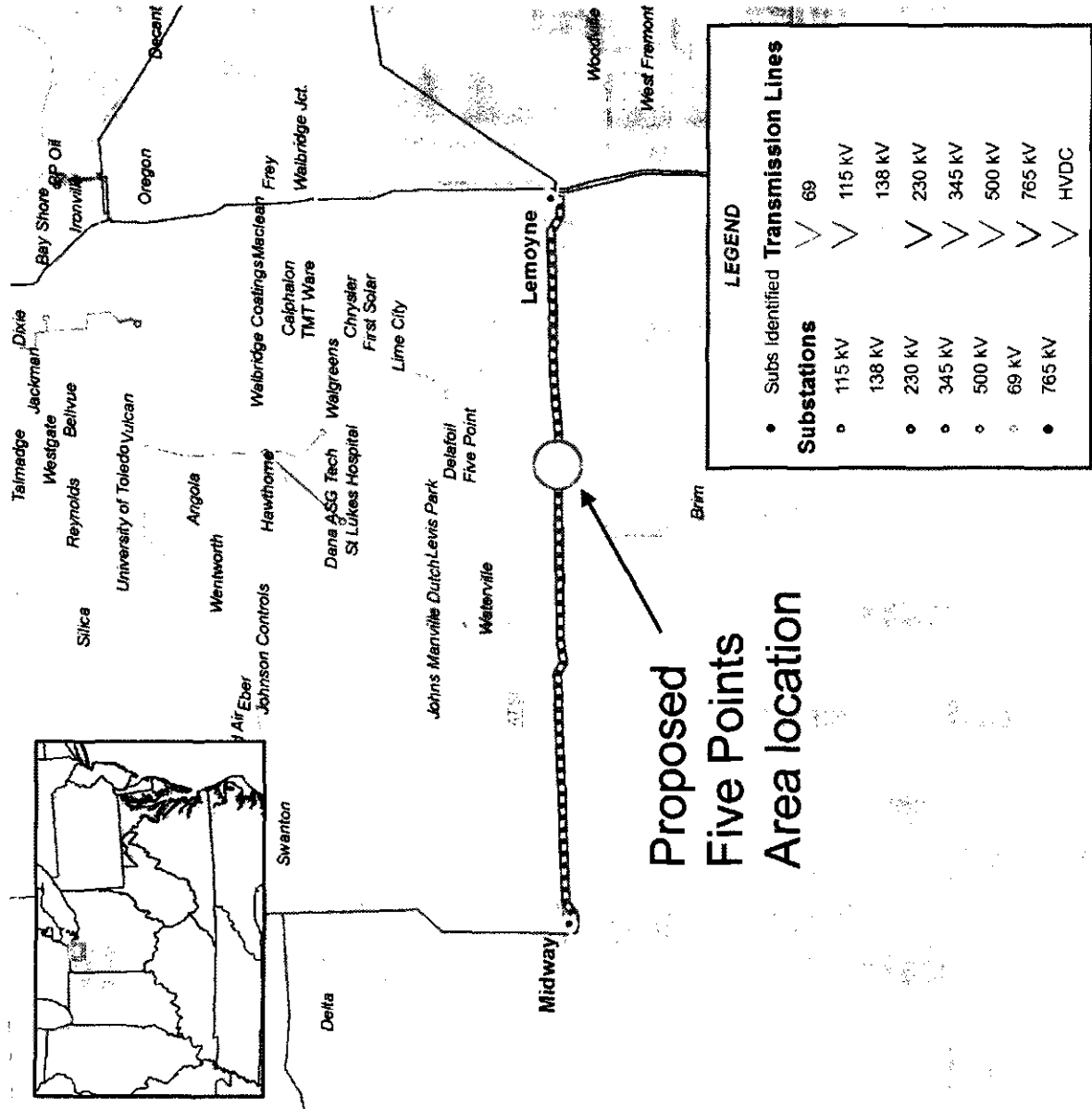
- Common Mode Outage Procedure: Galion 138kV breaker Failure, Brookside-Howard 138kV + Brookside-Leaside 138kV Common Tower Outage results in thermal overloads on Galion-Leaside 112%, and Galion-GM 101%
- Build a new Harmon - Brookside + Harmon - Longview 138 kV line
- Estimated Project Cost: \$9.2M
- Projected in-service date: 6/1/2015.





# ATSI Transmission Zone Reinforcement

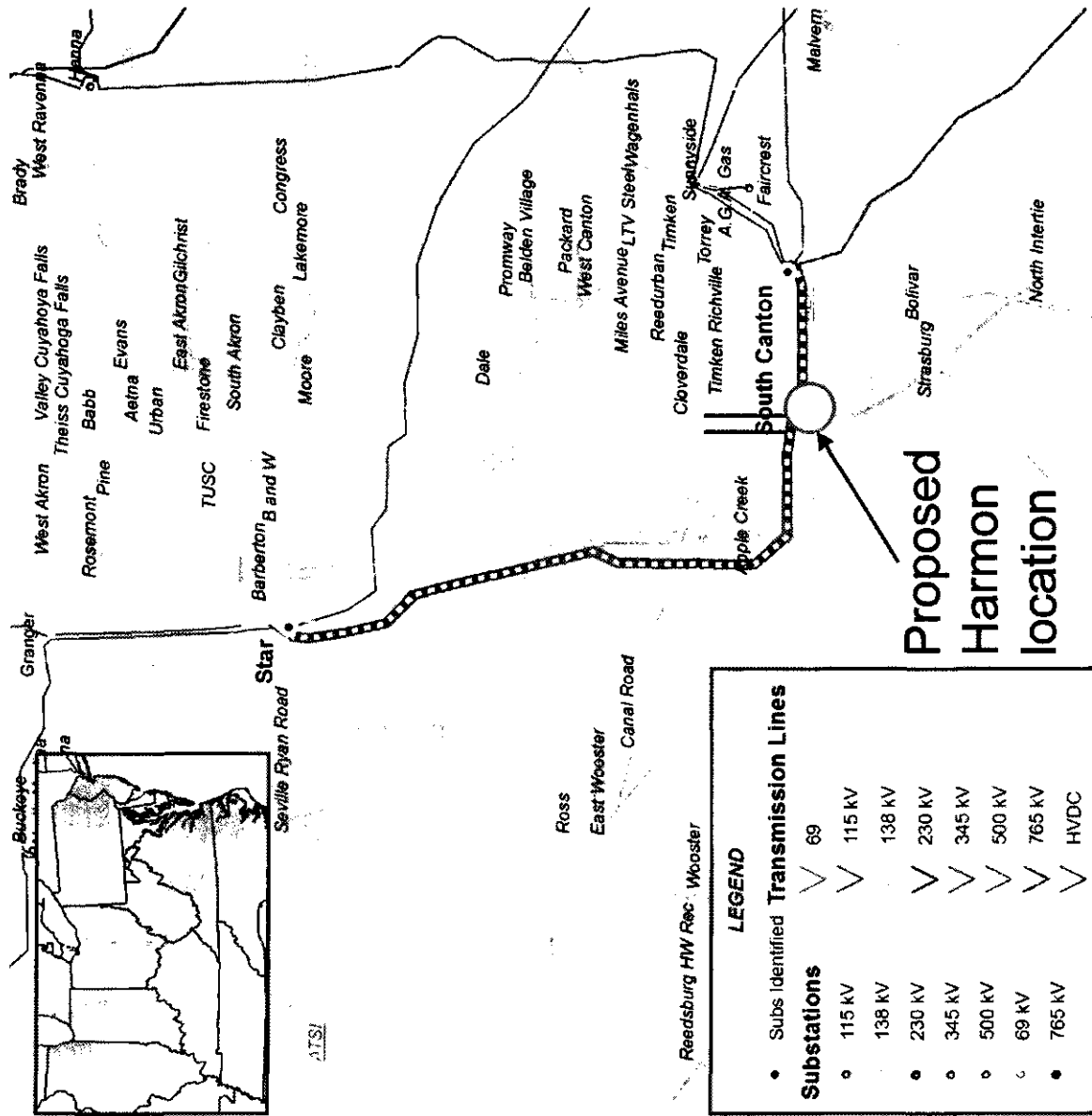
- N-1-1 Voltage Magnitude: Loss of Bayshore 345-138kV TR + Lemoyne-Maclean 138kV results in Low Voltage at Maclean 138kV 90%
- Create a new Five Points Area 345/138 kV substation by looping in the Lemoyne – Midway 345 kV line.
- Estimated Project Cost: \$30M
- Projected in-service date: 6/1/2015.





# ATSI Transmission Zone Reinforcement

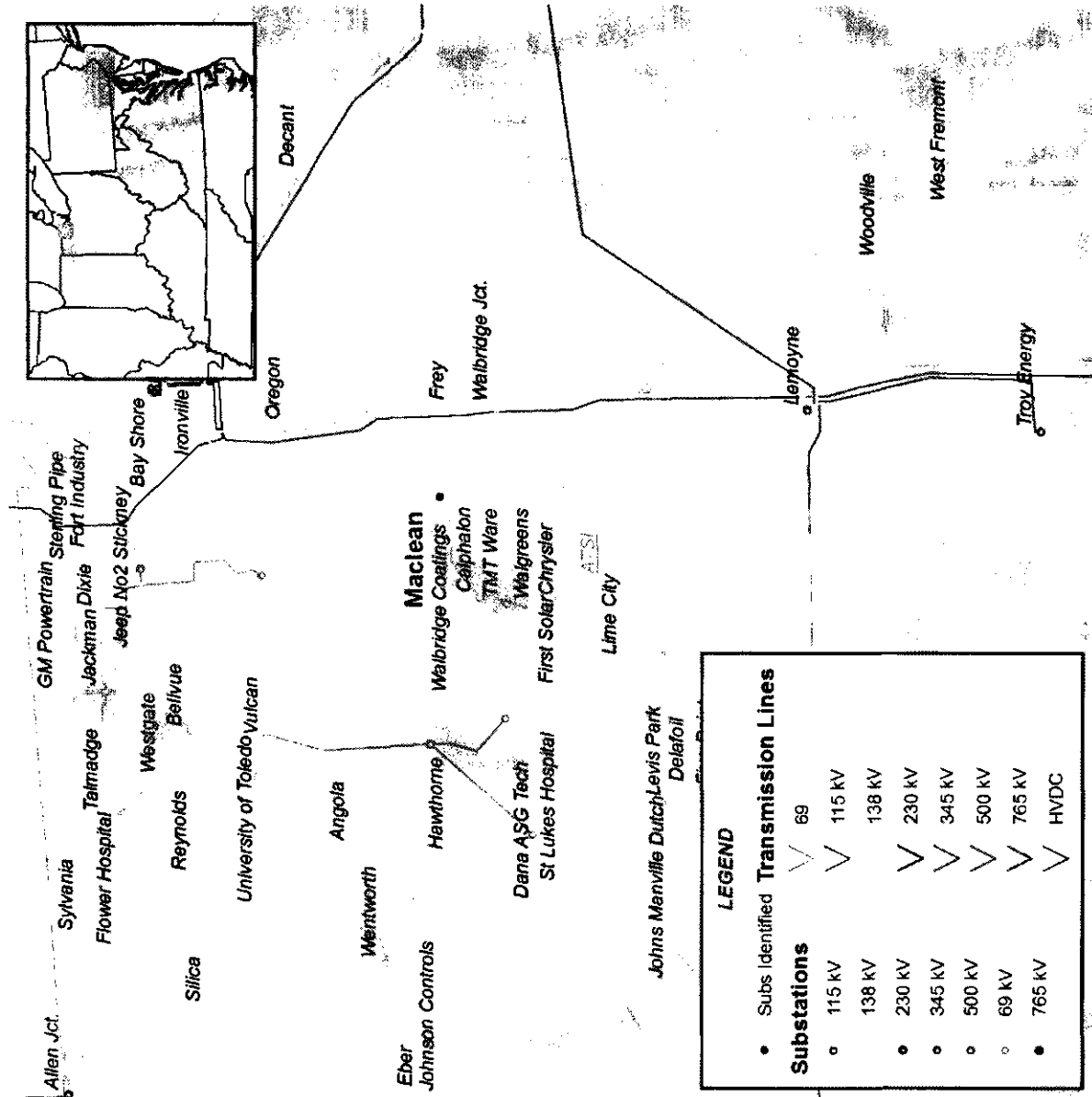
- N-1-1 Thermal for loss of one of the Cloverdale-Harmon 138kV lines + Harmon-Star 345kV line results in 115% OL on the remaining Cloverdale-Harmon 138kV line
- Reconductor Cloverdale-Harmon #2 and #3 138kV lines with 795 ACSS or greater conductor 6 miles total + Terminal upgrades. New Ratings 295 SN / 375 SE
- Estimated Project Cost: \$3.6M
- Projected in-service date: 6/1/2015





# ATSI Transmission Zone Reinforcement

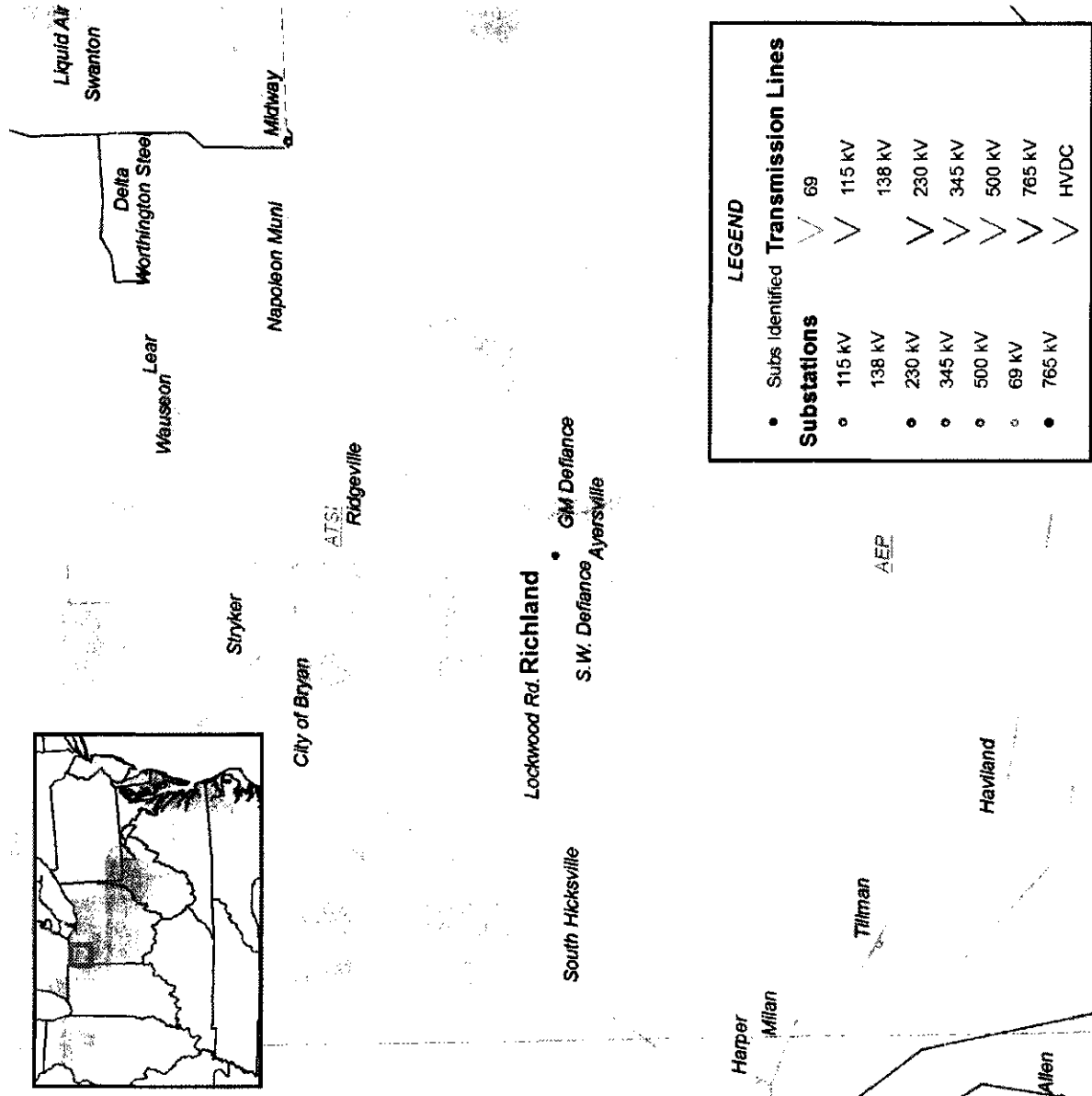
- N-1-1 Voltage Magnitude: (most severe) Lemoyne-Midway 345kV + Lemoyne-Maclean 138kV (91%)
- Change the transformer tap settings on the Maclean 138/69 kV transformers
- Estimated Project Cost: \$0.05M
- Projected in-service date: 6/1/2015





# ATSI Transmission Zone Reinforcement

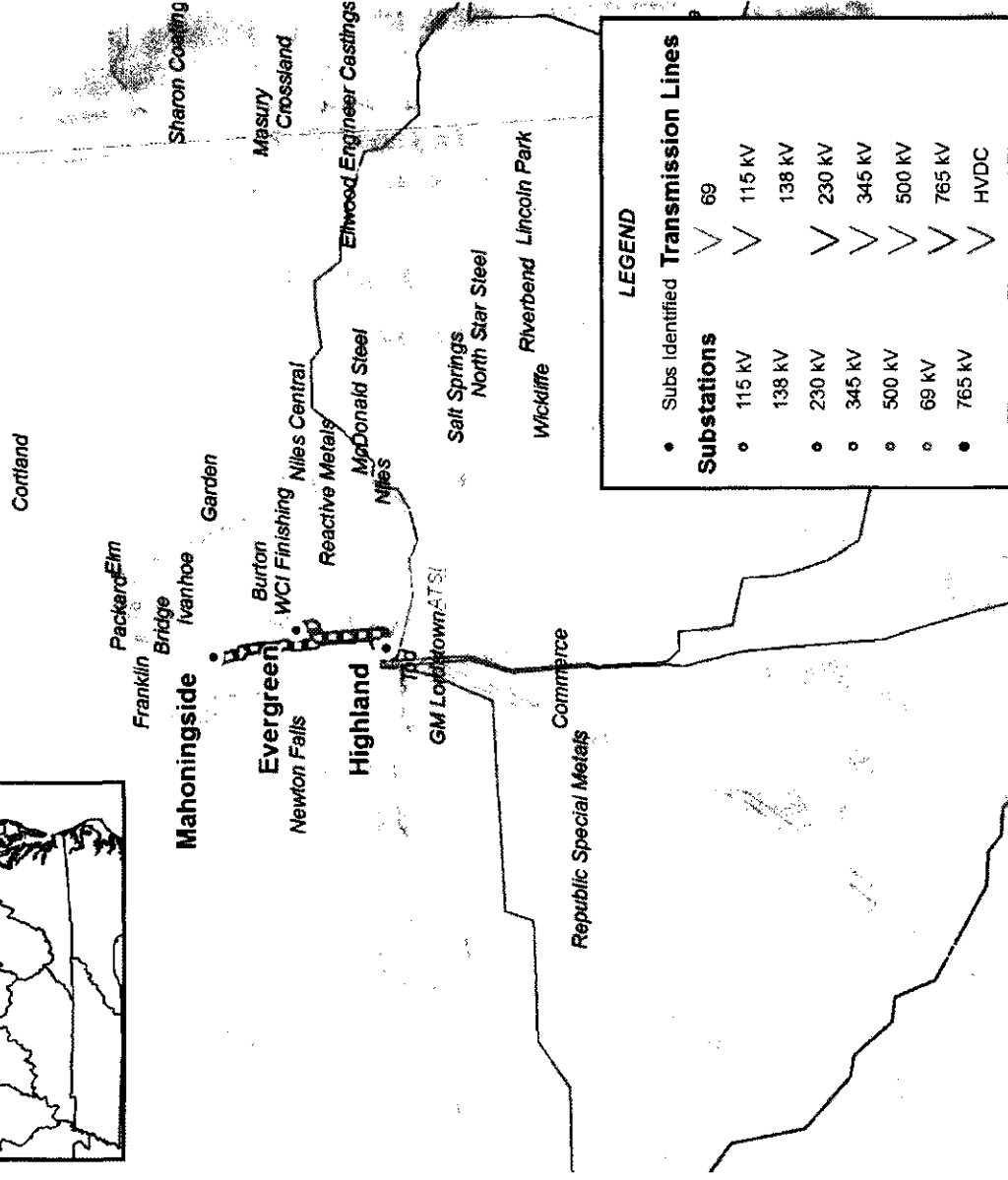
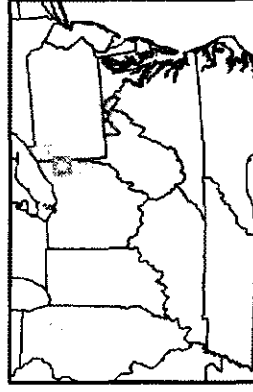
- Generator Deliverability: Loss of Richland N bus to Richland J bus section results in 108% overload on Richland-Naomi 138kV line
- Replace 336.4 ACSR SCCIR at Richland to upgrade the Richland - Naomi 138 kV line. New Ratings 161 SN / 191 SE
- Estimated Project Cost: \$0.04M
- Projected in-service date: 6/1/2015





## ATSI Transmission Zone Reinforcement

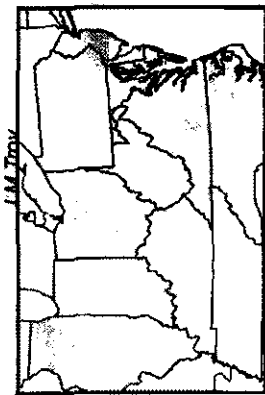
- N-1-1 Thermal (most severe) loss of Highland-Mahoningside 138kV + Evergreen-Highland #2 138kV results in 117% OL on Evergreen-Highland #1 138kV
- Build a new 345-138kV Substation at Niles. Requires 1.2 mile 345kV loop into substation of the Highland – Shenango 345 kV line. Requires new 345-138kV transformer. Project also increased short circuit levels to benefit power quality due to multiple EAF loads in the area.
- Estimated Project Cost: \$32M
- Projected in-service date: 6/1/2015





# ATSI Transmission Zone Reinforcement

- Generator Deliverability:  
Galion-Leaside 138kV +  
Galion-GM 138kV  
Common Tower Outage  
results in 115% overload  
on Brookside-Howard  
138kV line
- Build a new 138kV  
Substation near AEP /  
ATSI border + 138kV from  
new substation to  
Longview approx. 8 miles.
- Estimated Project Cost:  
\$17.7M
- Proposed in-service date:  
2016



AEP

Brookside

New Station

Howard

Shelby

Milliron

ATSI

Cornus

Madison

Longview

Ontario GM

Leaside

| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| • Substations     | 69                 |
| • 115 kV          | 115 kV             |
| • 138 kV          | 138 kV             |
| • 230 kV          | 230 kV             |
| • 345 kV          | 345 kV             |
| • 500 kV          | 500 kV             |
| • 69 kV           | 765 kV             |
| • 765 kV          | HVDC               |

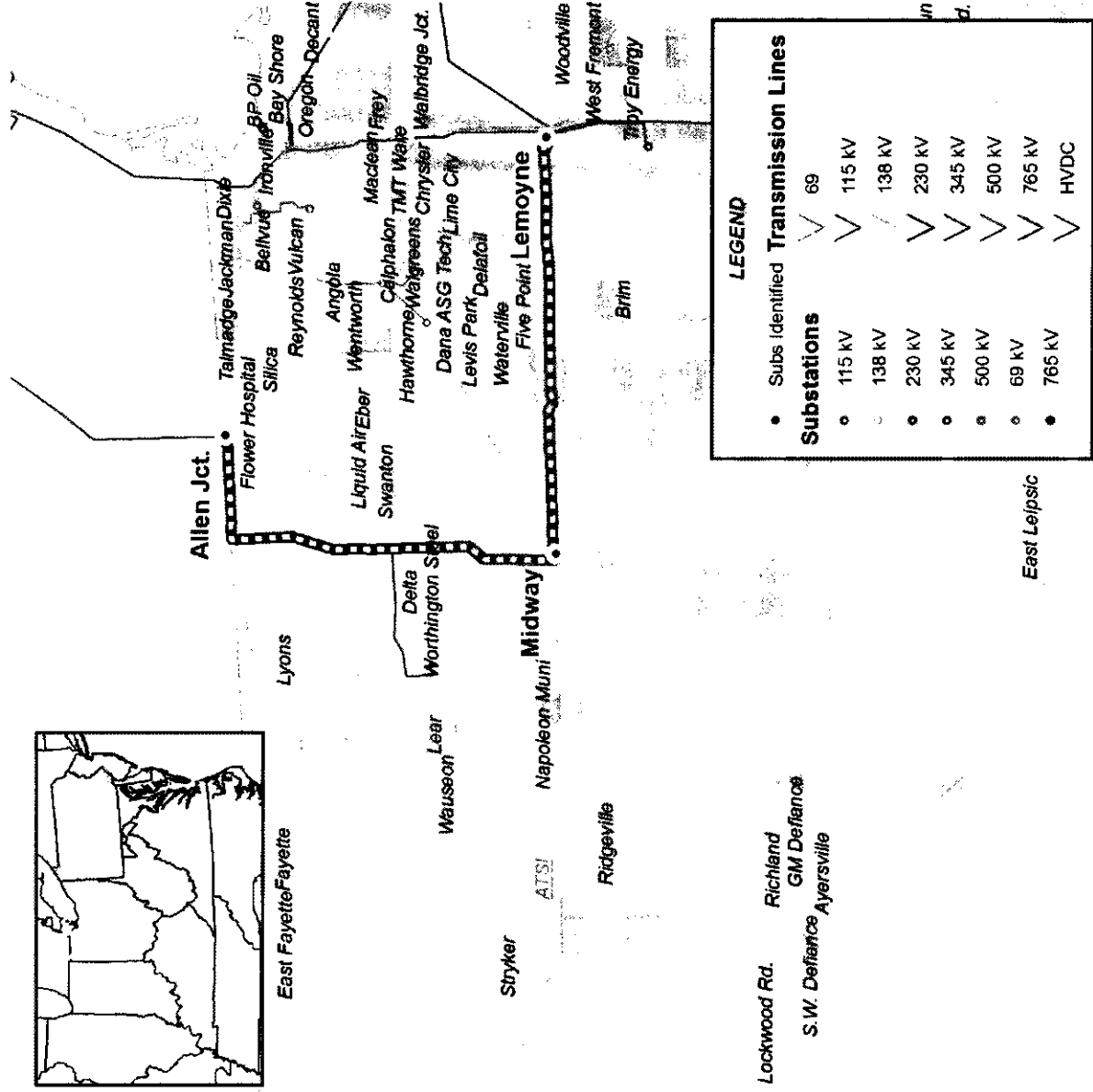
North Lexington

AEP



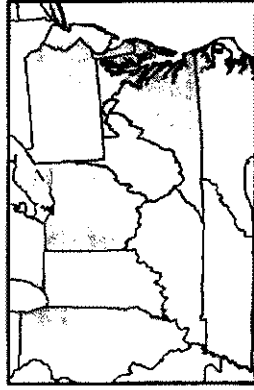
## ATSI Transmission Zone Reinforcement

- N-1-1 Thermal: Loss of Allen Junction-Lulu 345kV + Lemoyne-FivePoints 345kV results in 102% overload on Lemoyne-BG Tap 138kV
- Build new Allen Jct - Midway - Lemoyne 345kV line (48 miles of open tower position)
- Estimated Project Cost: \$86.3M
- Proposed in-service date: 6/1/2016

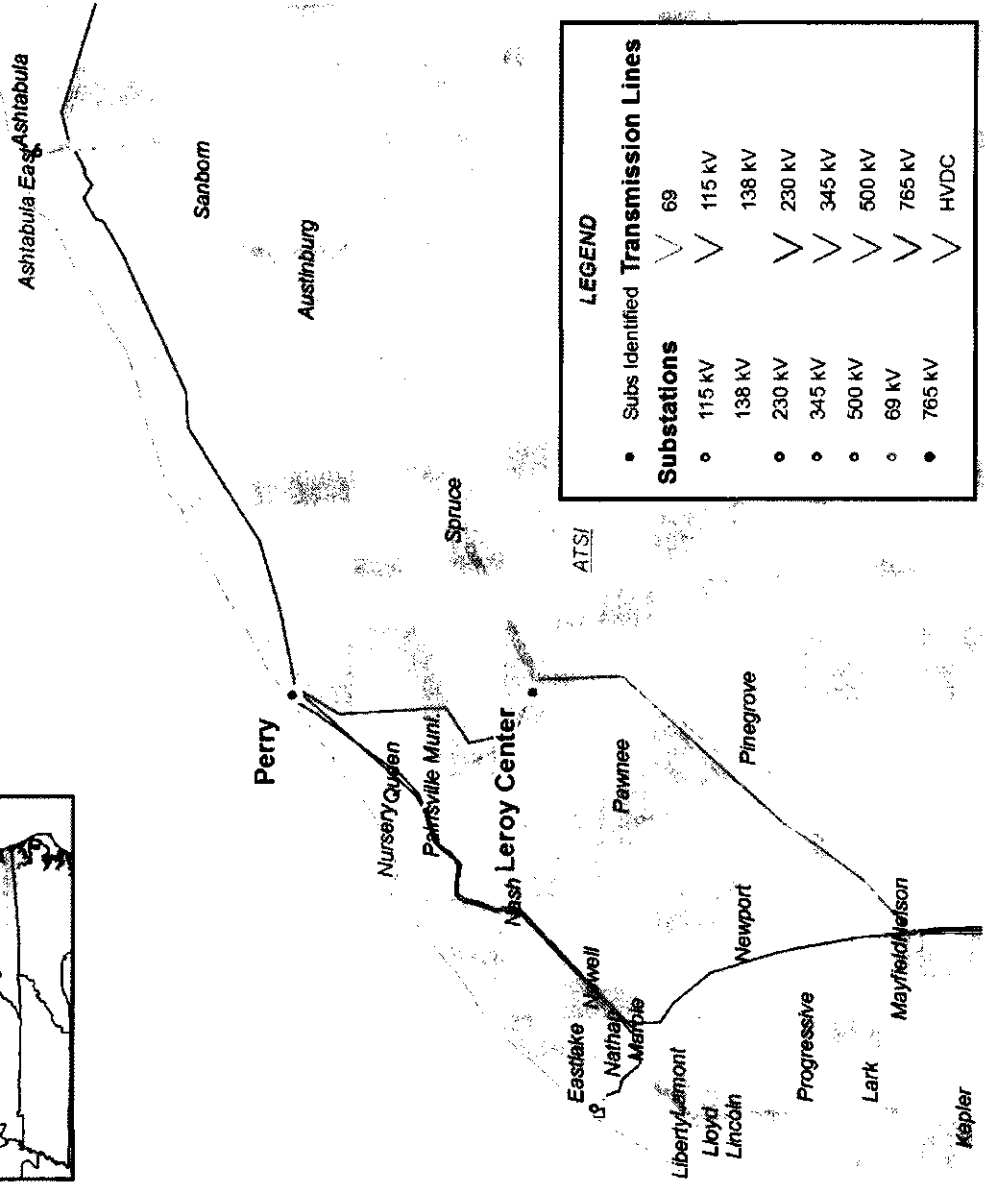




## ATSI Transmission Zone Reinforcement

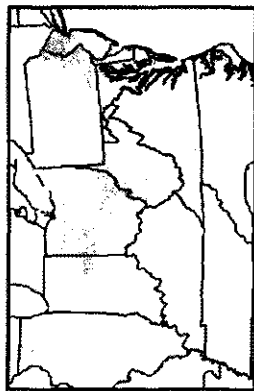


- **Mitigate Voltage Stability Criteria Issues in the Cleveland Area**
- Build a new Leroy Center 345/138 kV substation by looping in the Perry – Harding 345 kV line.
- Estimated Project Cost: \$46 M
- Projected in-service date: 6/1/2016.

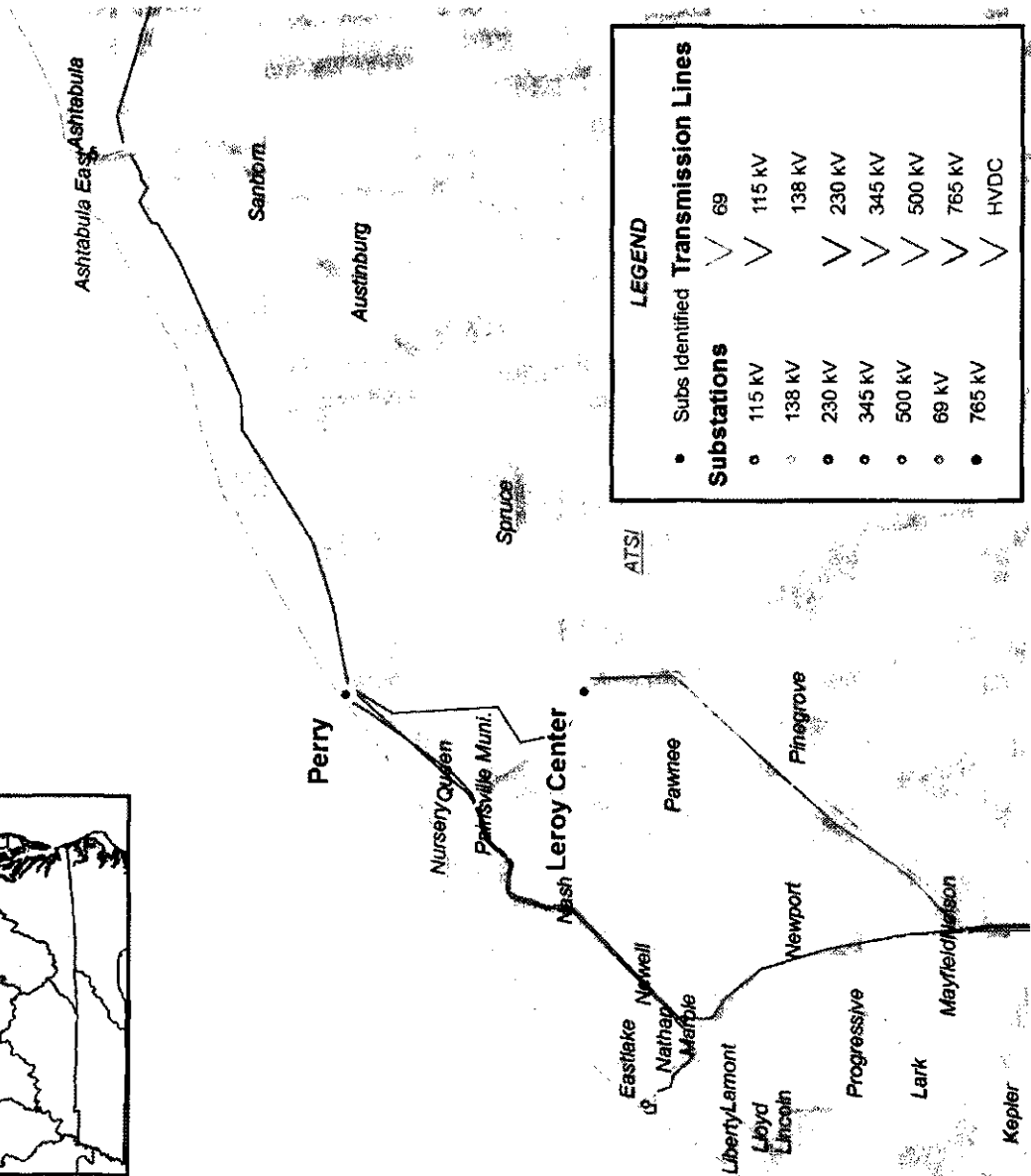




## ATSI Transmission Zone Reinforcement



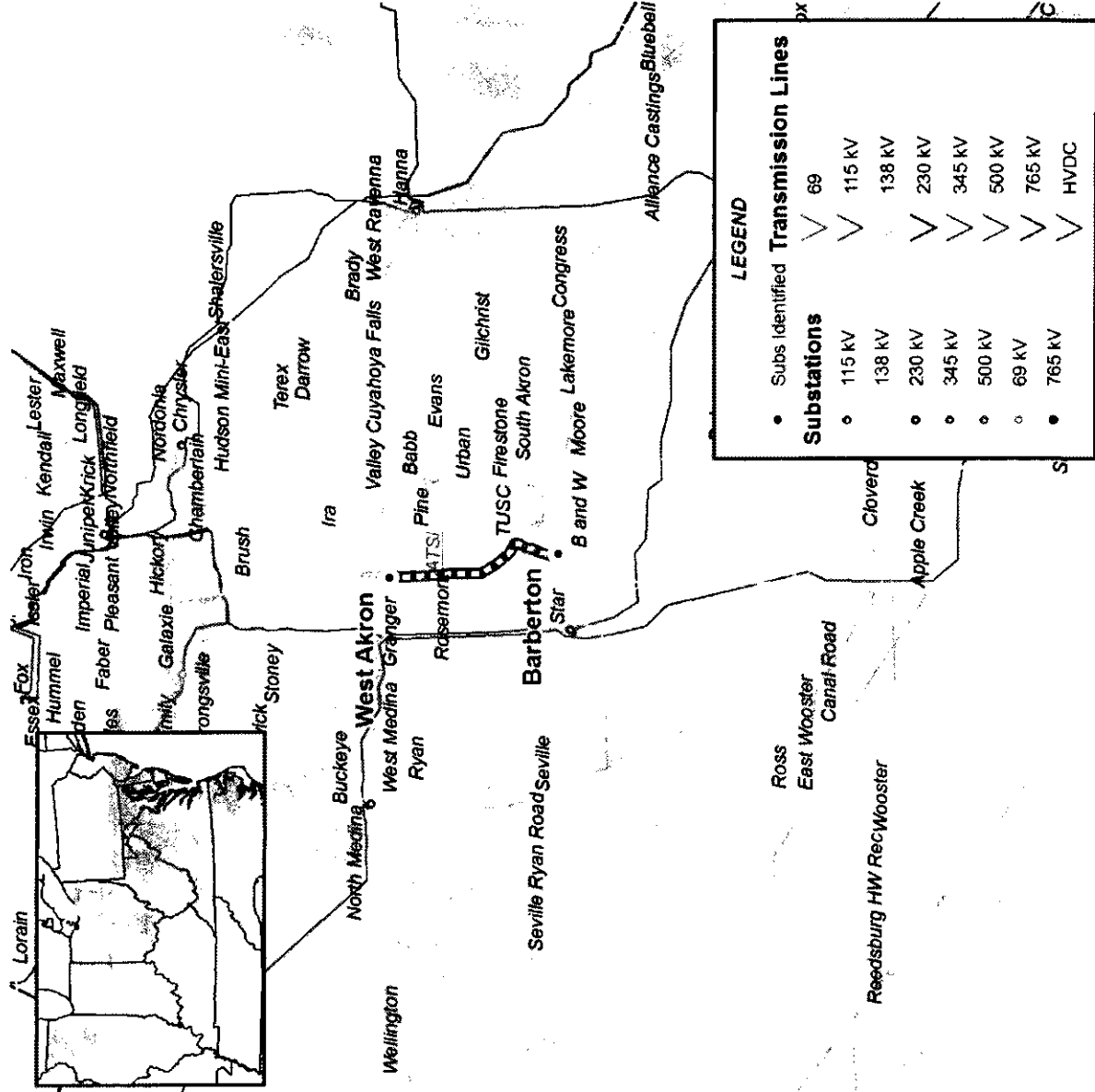
- Place a portion of the 138 kV Leroy Center 345/138 kV project into service by summer 2015 to alleviate the identified N-1-1 issues in the Mayfield to Ashtabula area. This project basically allows closing in the normally open Eastlake - Leroy Center 138kV lines (Q-12 and Q-11).
- Estimated Project Cost: \$3.3 M
- Projected in-service date: 6/1/2015.





# ATSI Transmission Zone Reinforcement

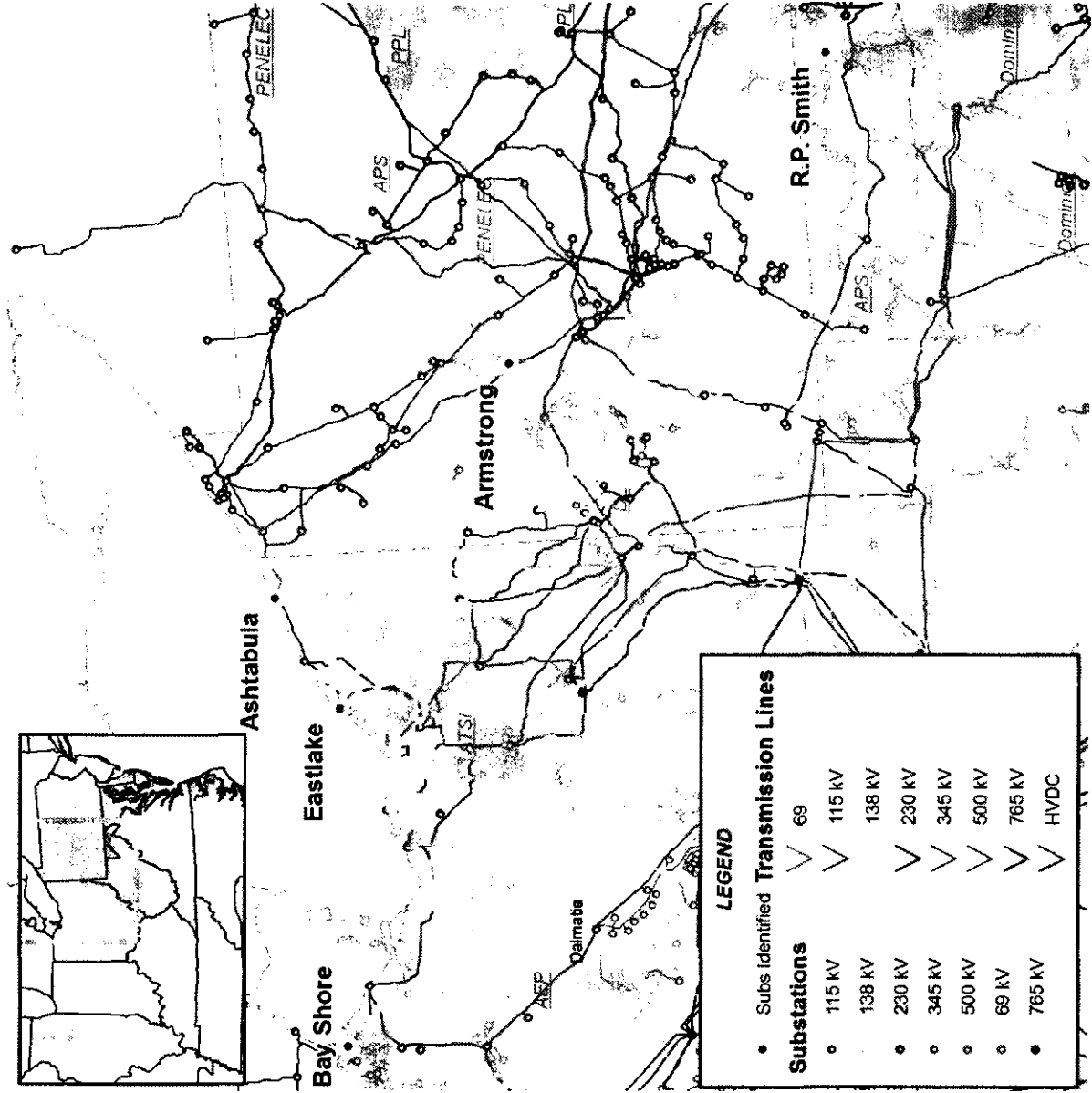
- The Barberton – West Akron 138 kV line is loaded to 105.9% of its normal rating for N-1-1: Loss of the Star – Wadsworth 138 kV line + BASECASE.
- Reconduct the Barberton – West Akron 138 kV line with 477 ACSS or greater (7.3 miles) + Terminal upgrades at Barberton.
- Estimated Project Cost: \$4.23 M
- Projected in-service date: 6/1/2016.





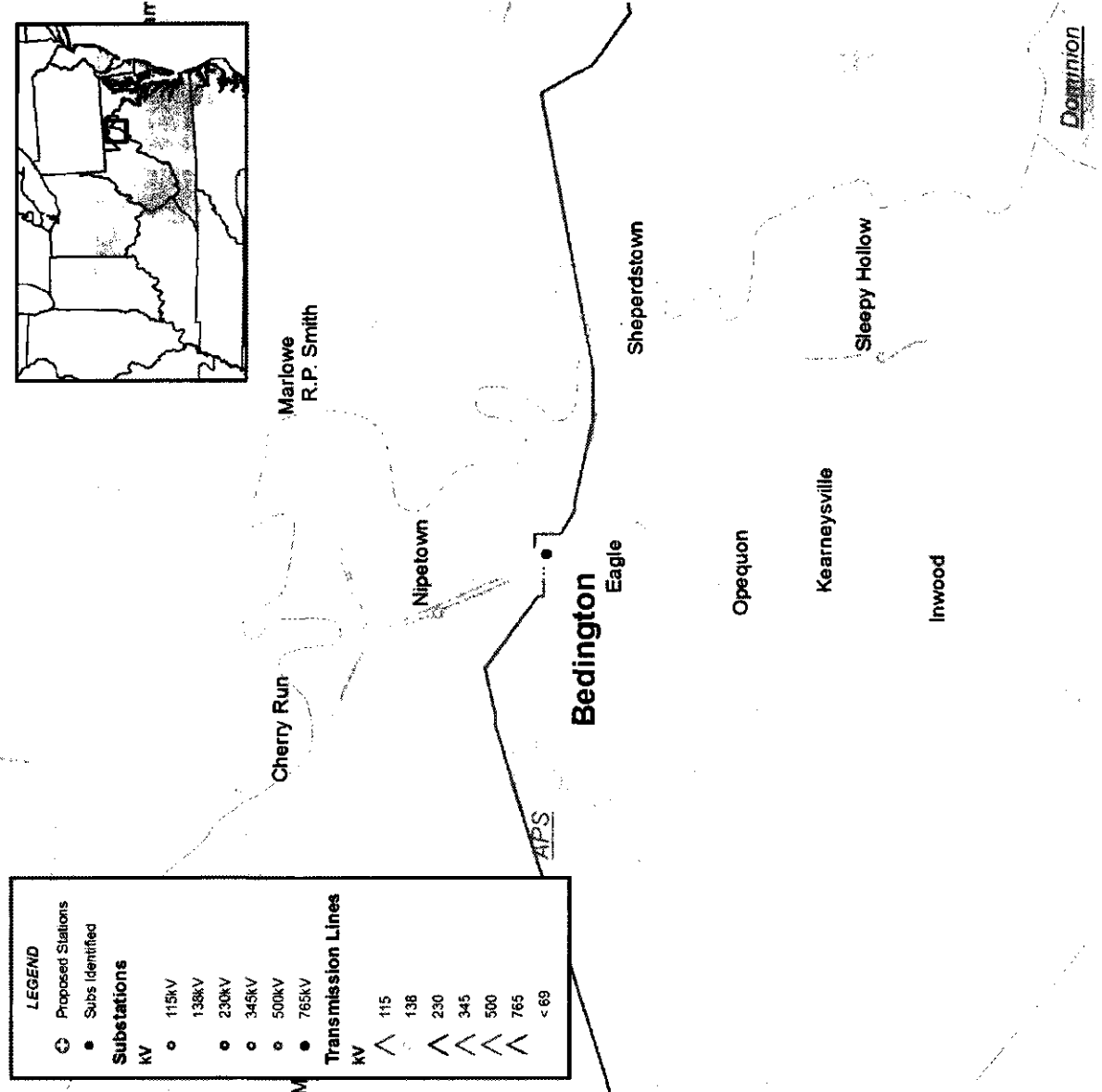
## AP Transmission Zone Violations

- Criteria violations
  - N-1-1 Thermal
  - Generation Deliverability
- Multiple 138kV thermal violations
- Required upgrades are shown on the following slides





## AP Transmission Zone Reinforcement



- Replace breaker risers and wave traps at Marlowe 138 kV.
- Replace wave traps at Bedington 138 kV (existing base line upgrade b1837)
- Cost Estimate \$0.6M
- Expected in-service date is 6/1/2013.

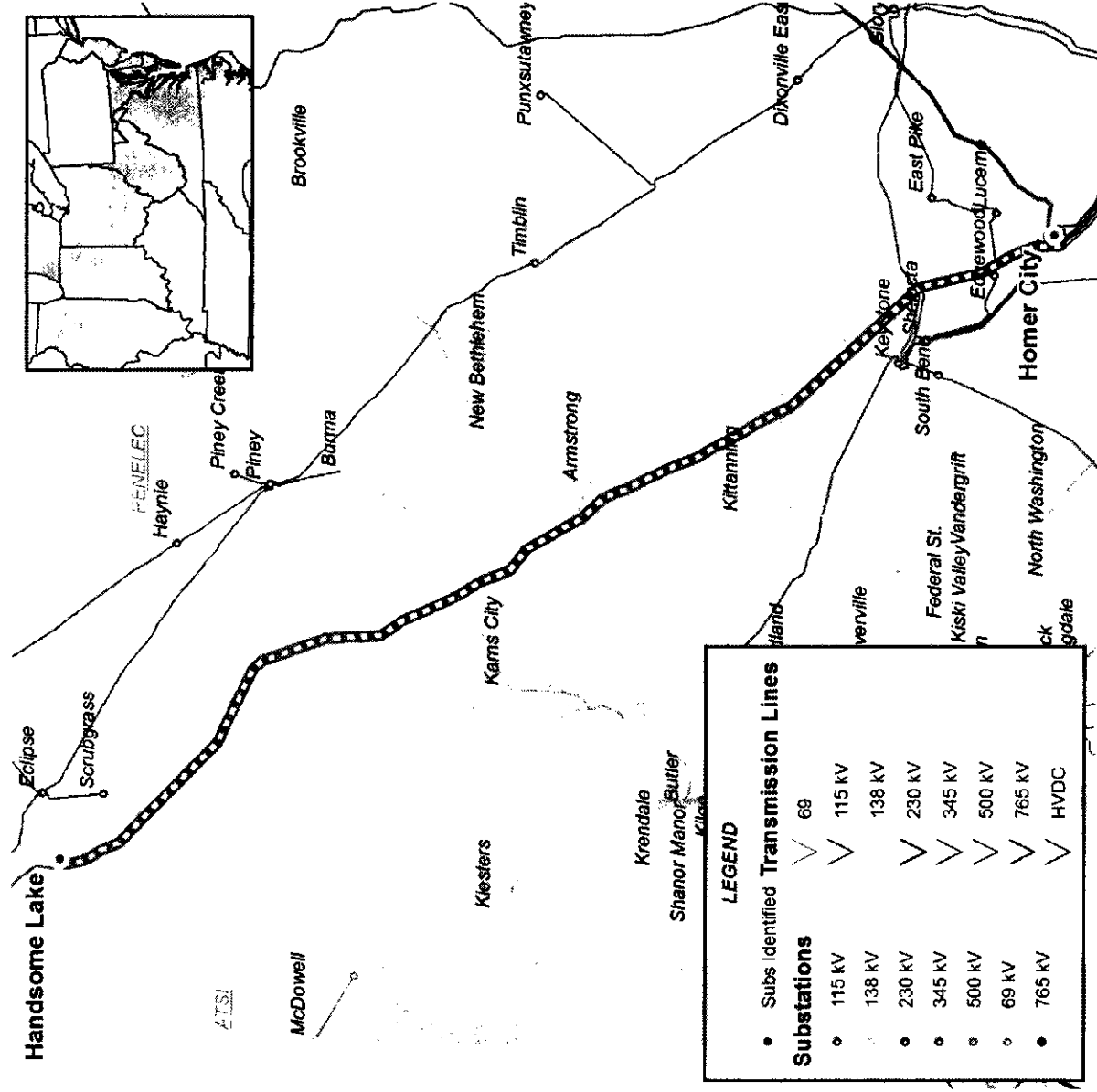




# AP Transmission Zone Reinforcement

- The Shaffers Corner-Springdale 138 kV line loads to 129.8% of its emergency rating (297 MVA) for the loss of the Cabot – Woodland 138 kV line + loss of Allegheny Ludlum 4 Junction - Springdale 138 kV line.
- Loop the Homer City-Handsome Lake 345 kV line into the Armstrong substation and install a 345/138 kV transformer at Armstrong.

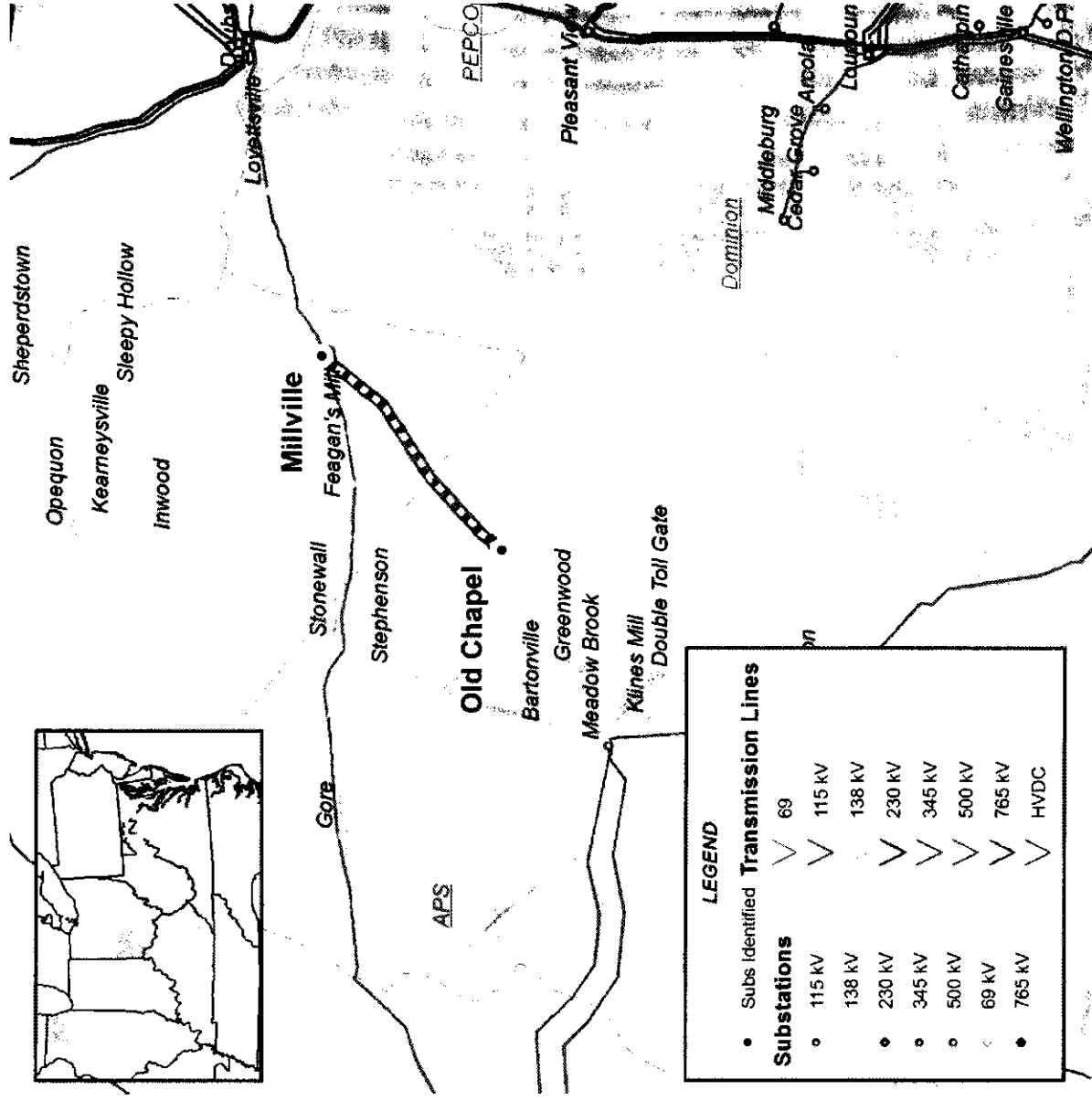
- Estimated Project Cost: \$27.8M
- Projected in-service date 6/1/2014





## AP Transmission Zone Reinforcement

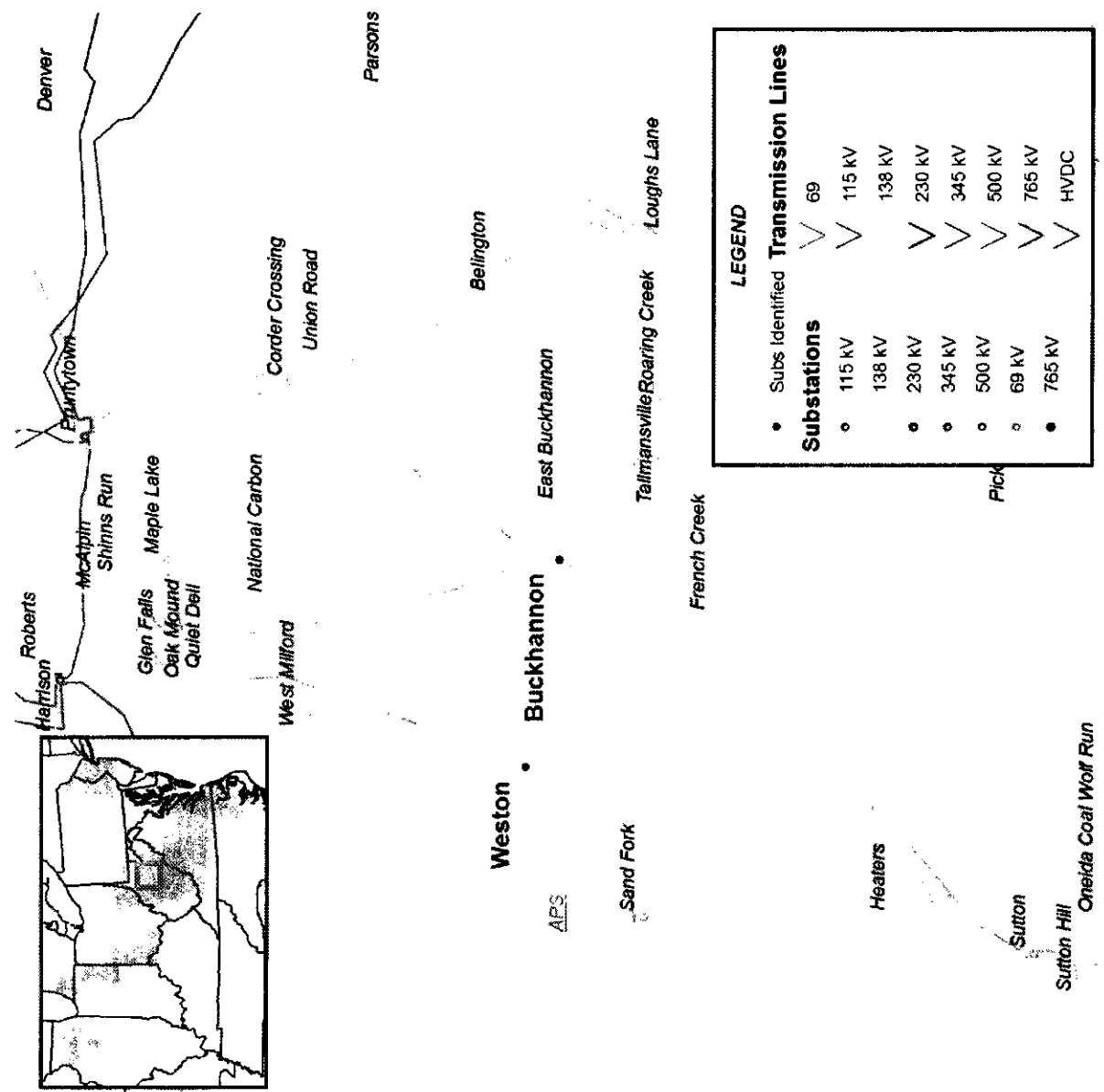
- The Millville – Old Chapel 138 kV line is overloaded at 120.5% (214 MVA) for the N-1-1 loss of the Loudoun – Meadowbrook 500 kV line + the loss of Morrisville – Front Royal 500 kV line.
- Change the CT ratio at Millville to improve the Millville – Old Chapel 138 kV line ratings.
- Estimated Project Cost: \$0.05M
- Projected in-service date: 6/1/2015.





# AP Transmission Zone Reinforcement

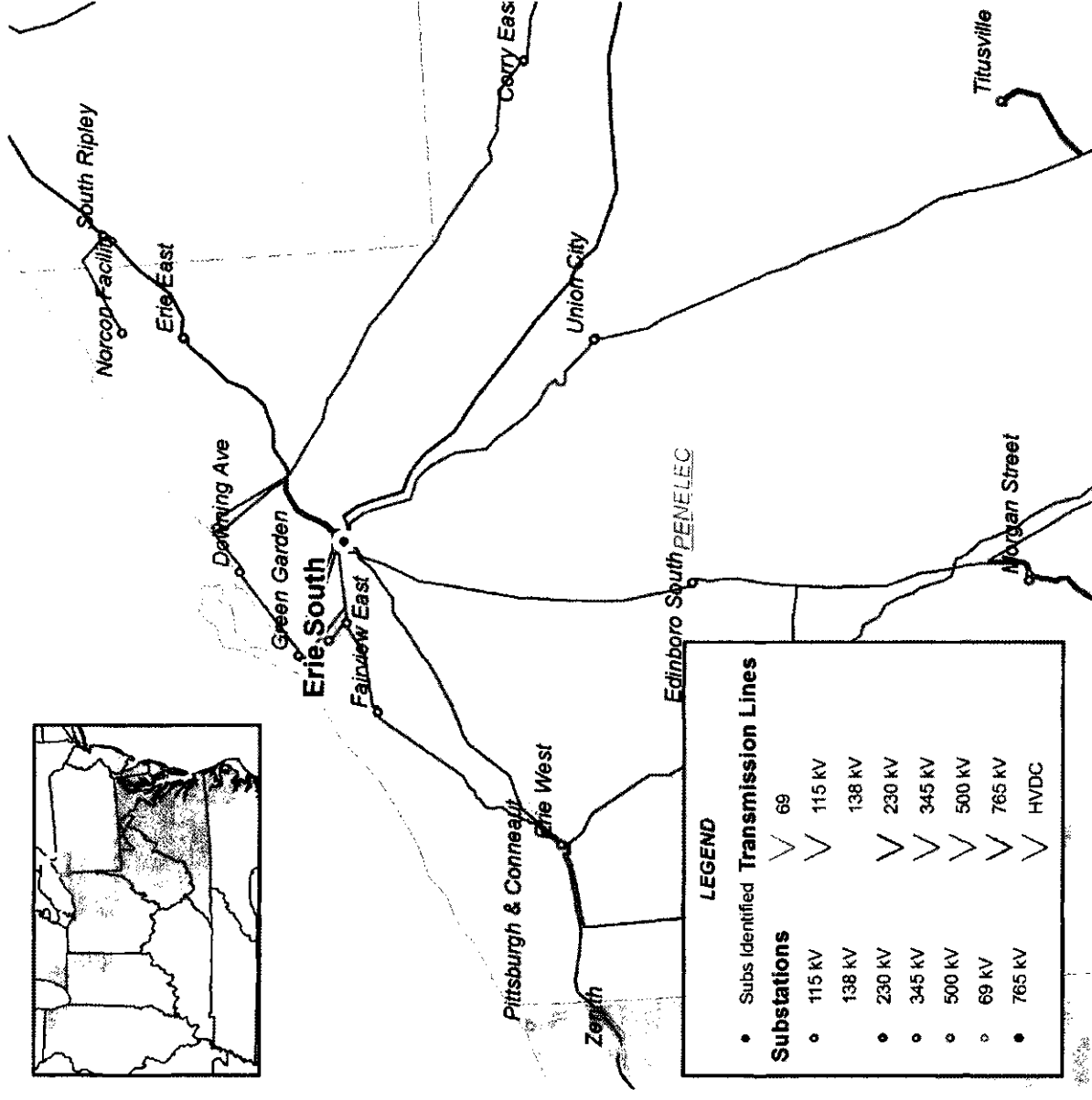
- The Goff Run 138 kV bus voltage drop is 17.18% for the loss of Glen Falls – Oakmound 138 kV line followed by loss of Maple Lake - Pruntytown 138 kV line.
- Install a new Buckhannon – Weston 138 kV line (b1840).
- Estimated Project Cost: \$17.5M
- Projected in-service date: 6/1/2016.





## PN Transmission Zone Violations

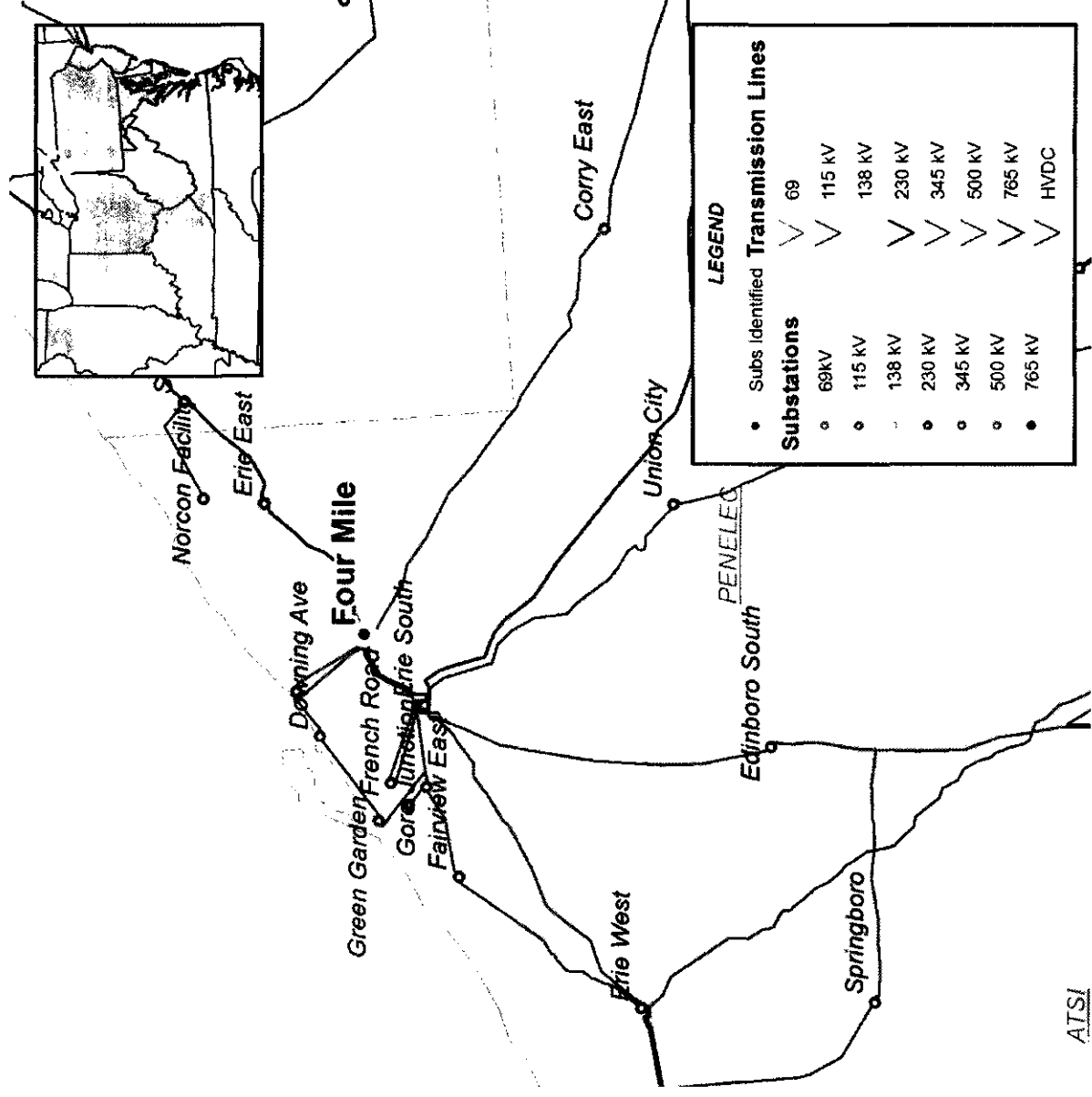
- Criteria violations
  - Generator Deliverability
  - N-1-1 Thermal
- Erie South 230/115kV transformer #1
- Erie South 230/115kV transformer #6
- Eclipse – Clark Summit 115 kV line
- Seward 230/115 kV transformer #9
- Upgrades are shown on the following slides





## PN Transmission Zone Reinforcement

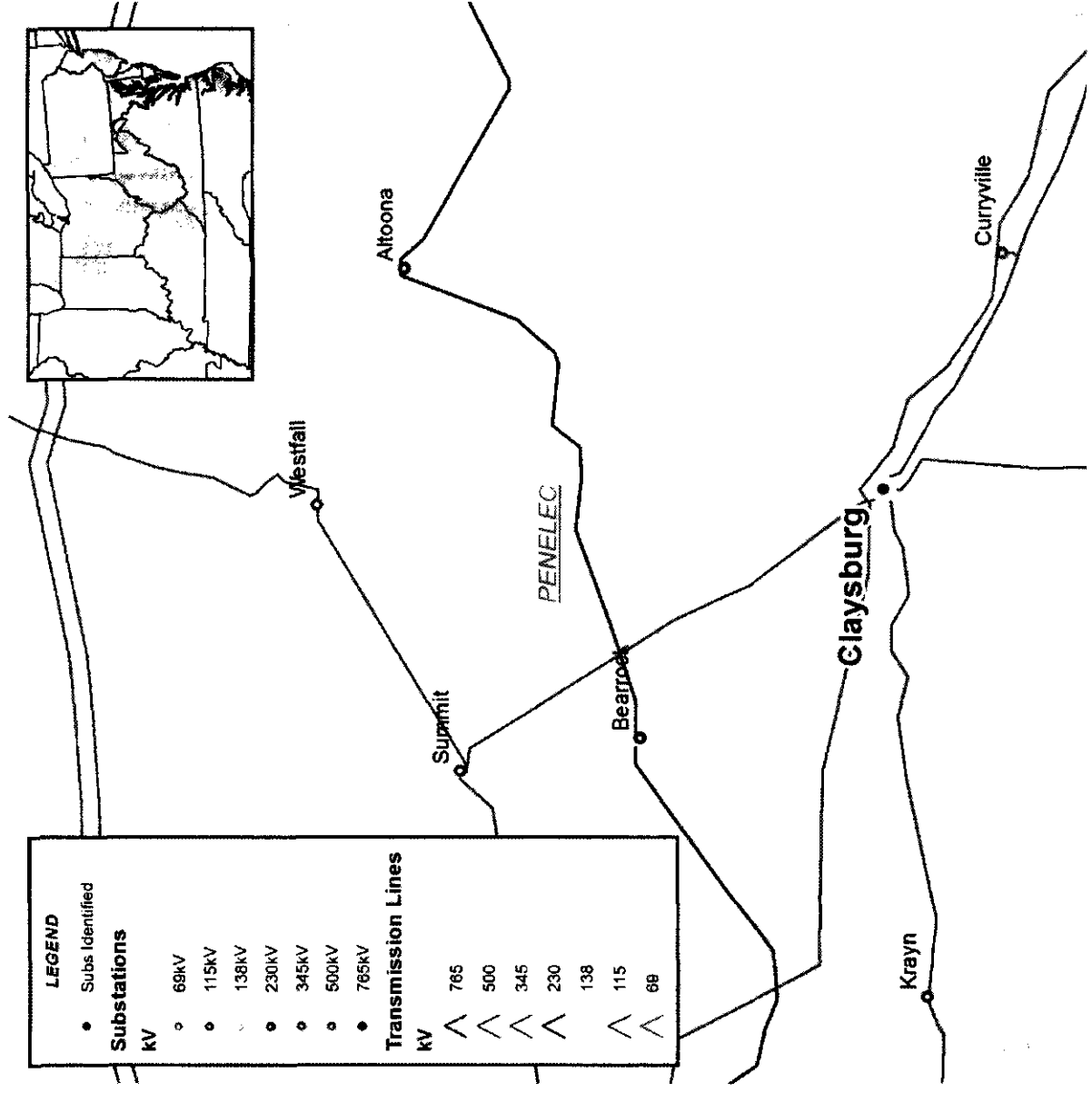
- Construct Four Mile Junction 230/115 kV substation (existing base line upgrade b1609)
- Estimated Project Cost: \$17.9M
- Projected in-service date: 6/1/2014





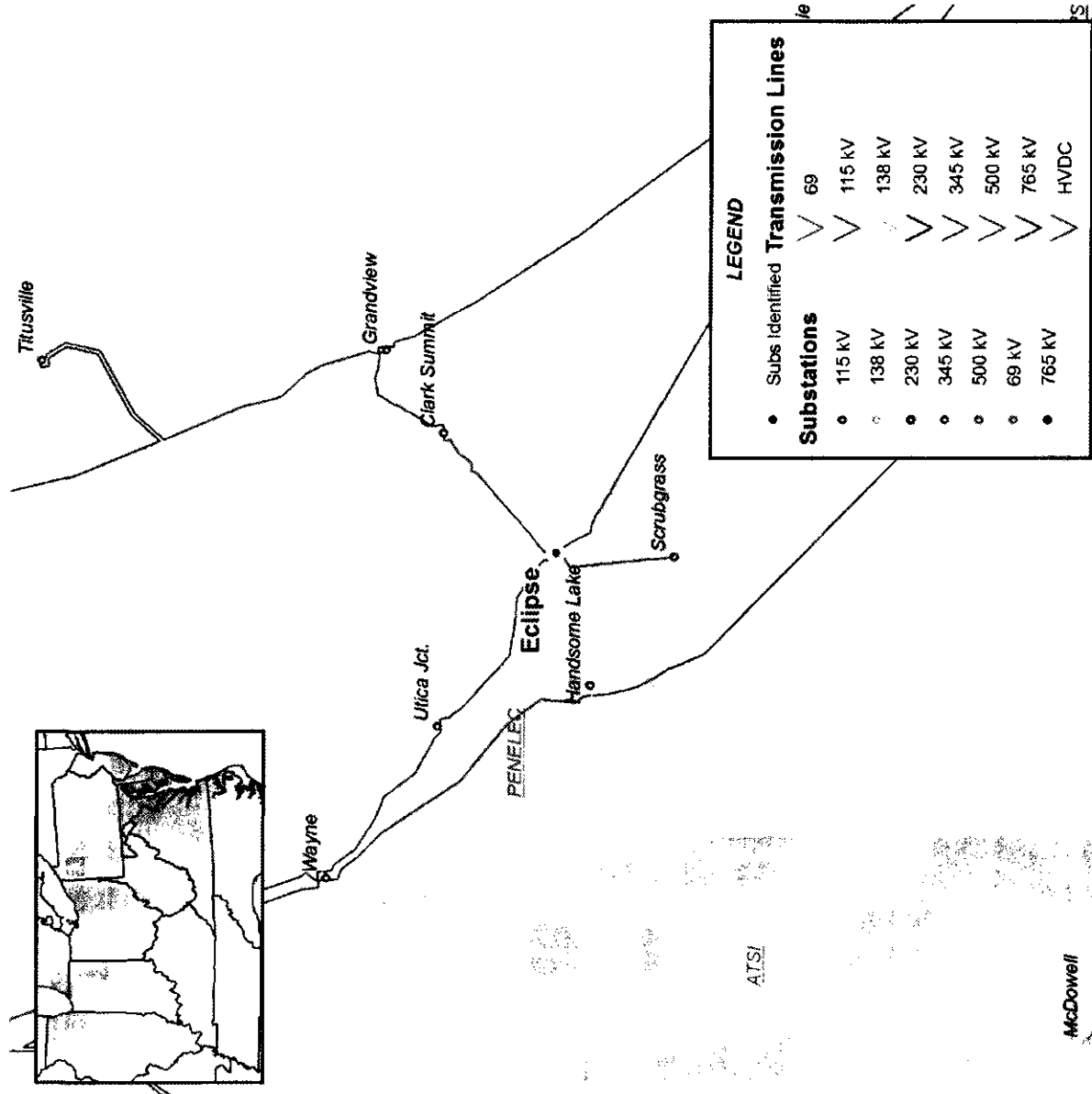
## PN Transmission Zone Reinforcement

- Stuck breaker contingency loss of Claysburg bus, Curryville bus, and Osterburg East 115/23 kV transformer causes a voltage collapse.
- Construct a 115 kV ring bus at Claysburg Substation. Bedford North and Saxton lines will no longer share a common breaker.
- Estimated Project Cost: \$5.25 M
- Projected in-service date: 6/1/2015.





## PN Transmission Zone Reinforcement

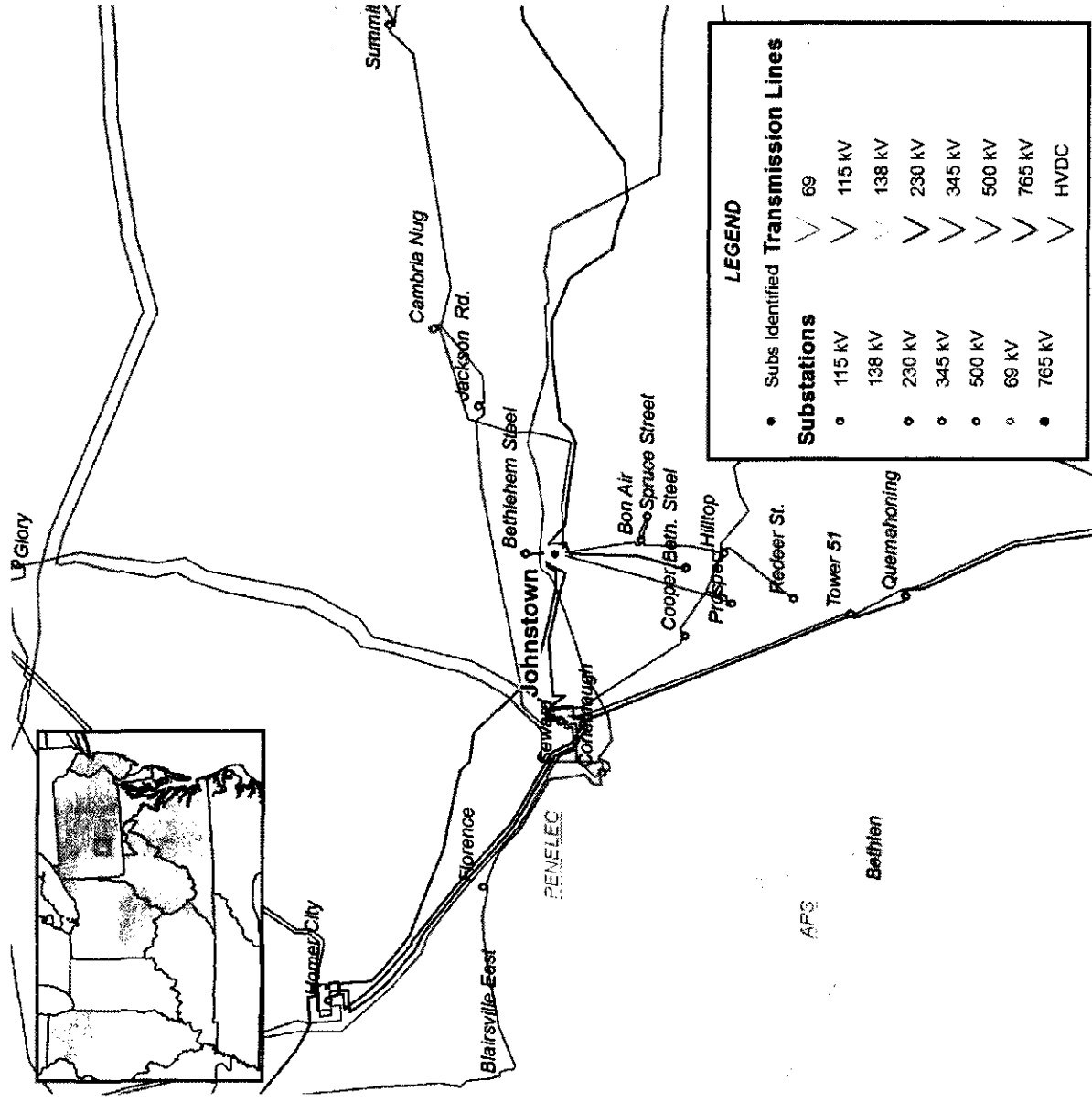


- The Eclipse - Clark Summit 115 kV line is overloaded to 109.7% of Rate A (101 MVA) from the loss of Piney - Haynie 115 kV line + Basecase.
- Reconnector Eclipse substation 115 kV bus with 1033 kcmil conductor.
- Estimated Project Cost: \$150 K
- Projected in-service date: 6/1/2013.



## PN Transmission Zone Reinforcement

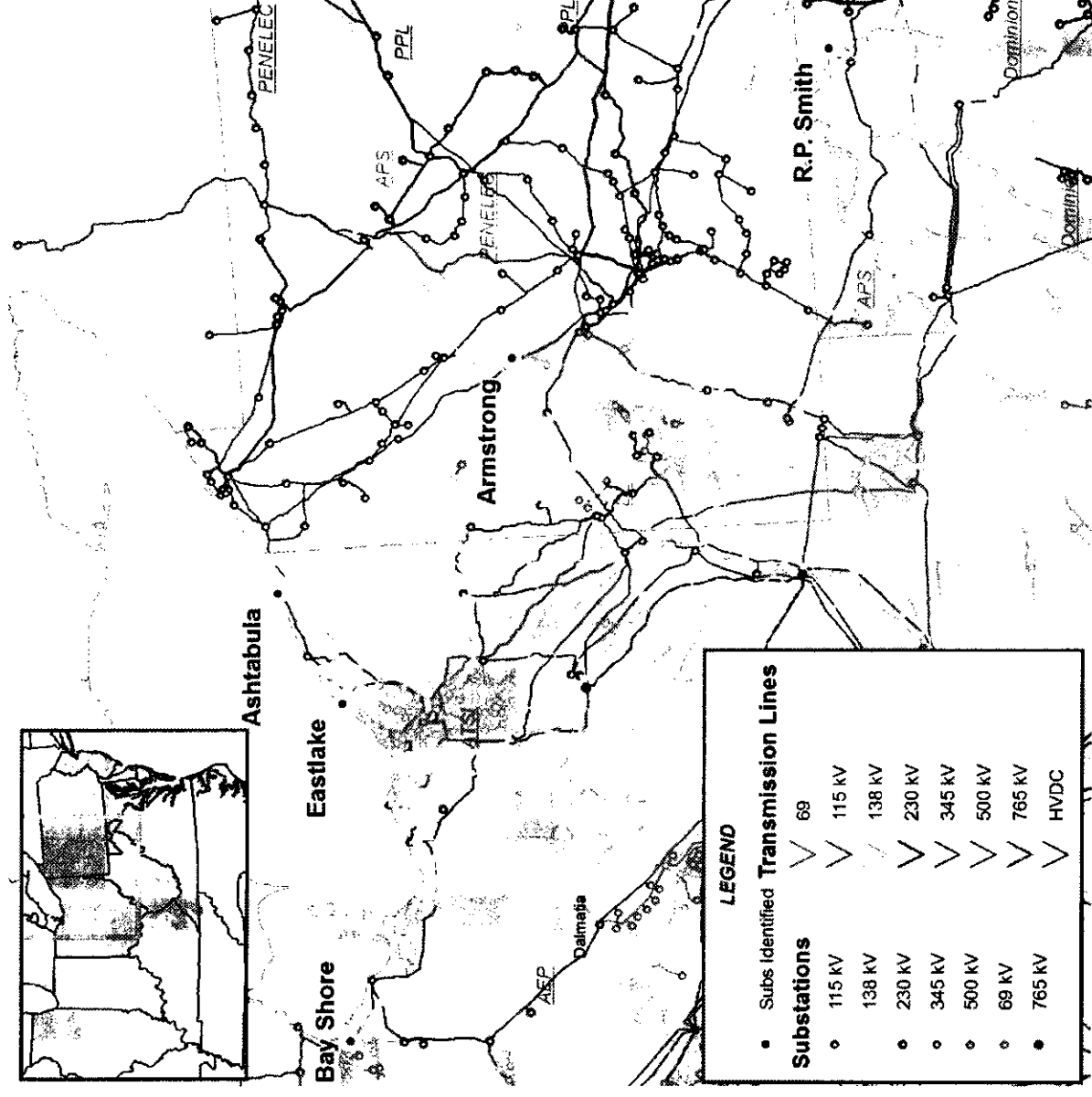
- The Seward 230/115 kV transformer #9 is loaded to 103.2% if its emergency rating (300 MVA) for the N-1-1 loss of the Seward 230/115 kV transformer #11 followed by loss of Johnstown 230 kV and Bar Tech 230 kV buses.
- Install second 230/115 kV autotransformer at Johnstown.
- Estimated Project Cost: \$4.5 M
- Projected in-service date: 6/1/2015.





## AEP Transmission Zone Violations

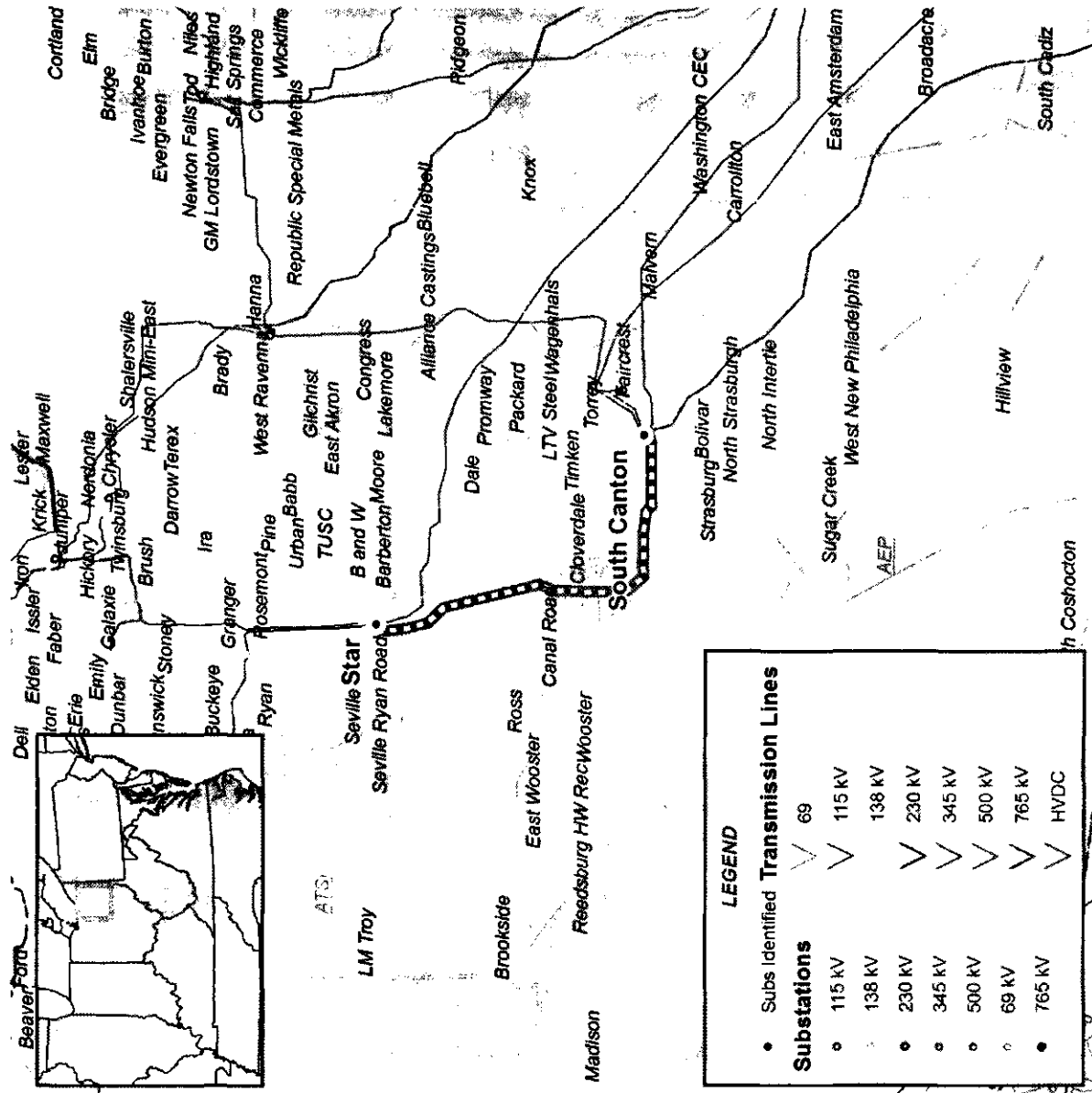
- Criteria violations
  - N-1-1 Thermal
  - Generation Deliverability
  - Load Deliverability
- Multiple 138kV thermal violations
- Kammer-West Bellaire 345kV line thermal violation
- South Canton - Star 345 kV line thermal violation (AEP-ATSI)
- Upgrades are shown on the following slides





# AEP Transmission Zone Reinforcement

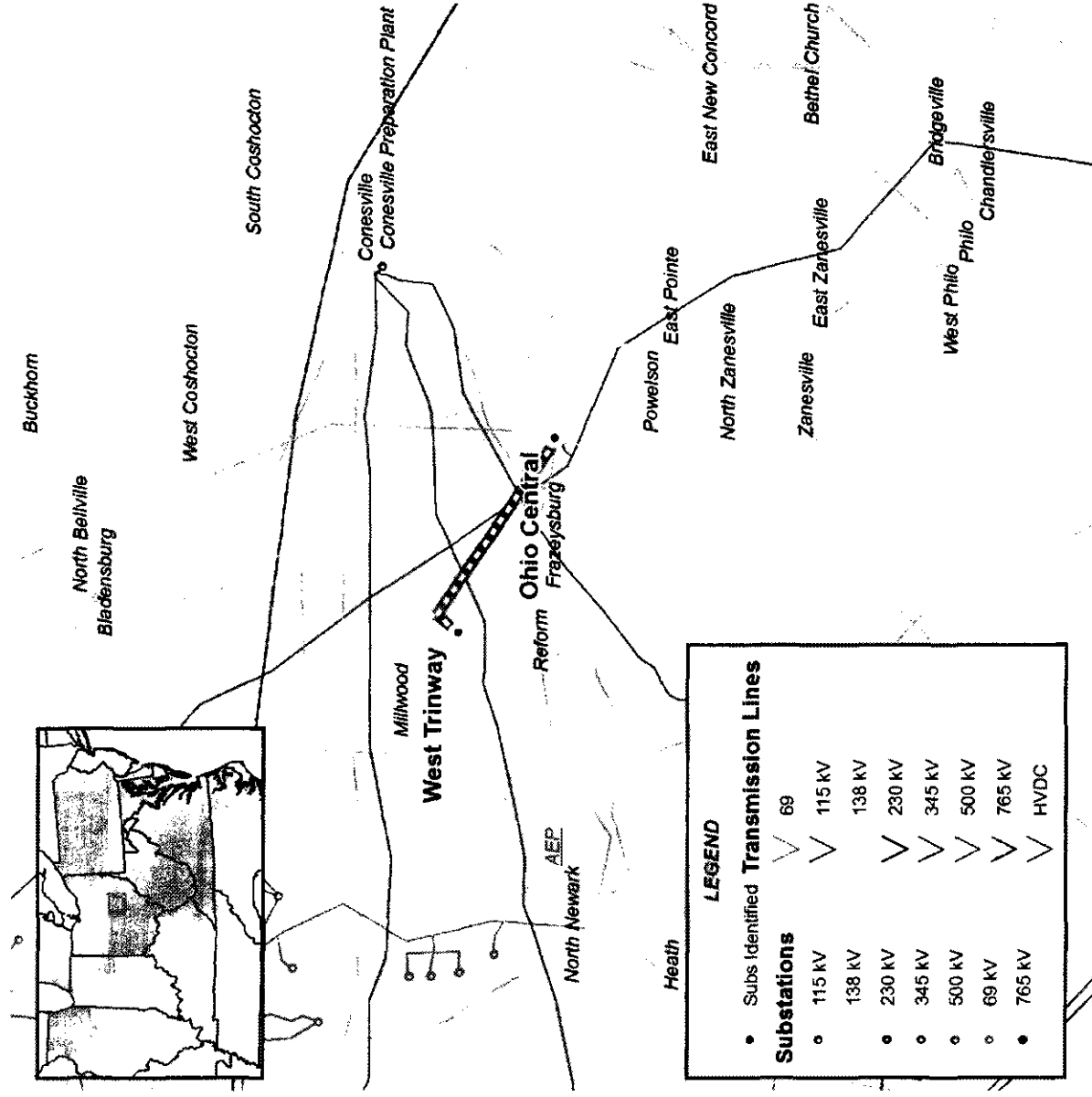
- Reconnector AEP portion of South Canton – Star 345 kV line and upgrade terminal equipment at South Canton (existing base line upgrade b1812)
- Estimated Project Cost: \$0.8M
- Projected in-service date: 12/31/2013





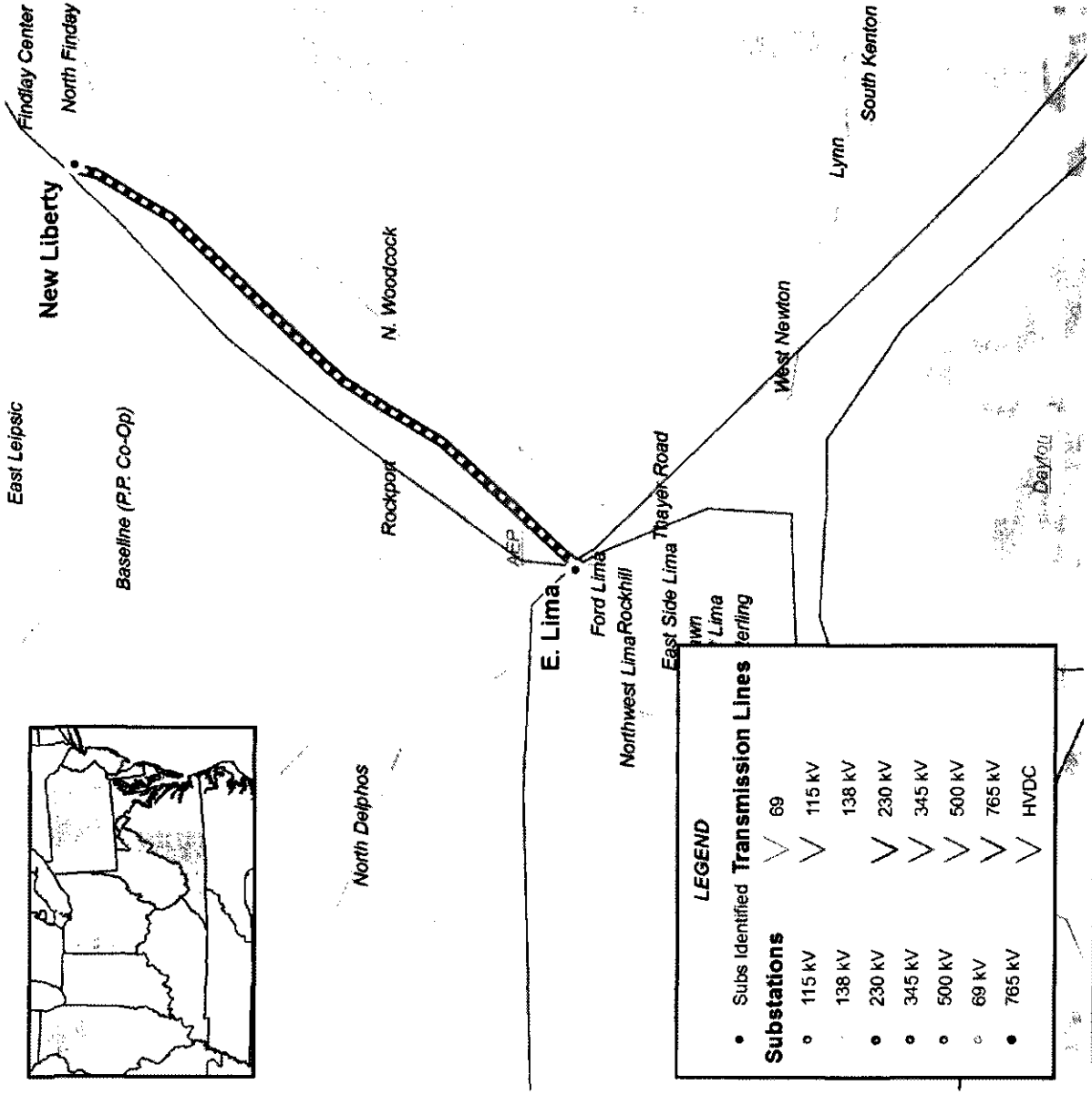
# AEP Transmission Zone Reinforcement

- Ohio Central – West Trinway 138 kV line loads to 102.1% of its emergency rating (205 MVA) for the single contingency loss of Sharp Road 138 kV bus.
- Advance 2016 baseline upgrade b1901 (Rebuild the Ohio Central – West Trinway (4.84 miles) section of the Academia – Ohio Central 138 kV circuit. Upgrade the Ohio Central riser, Ohio Central switch and the West Trinway riser) to 2015.
- Estimated Project Cost: \$4.8 M
- New Projected in-service date: 6/1/2015.





## AEP Transmission Zone Reinforcement



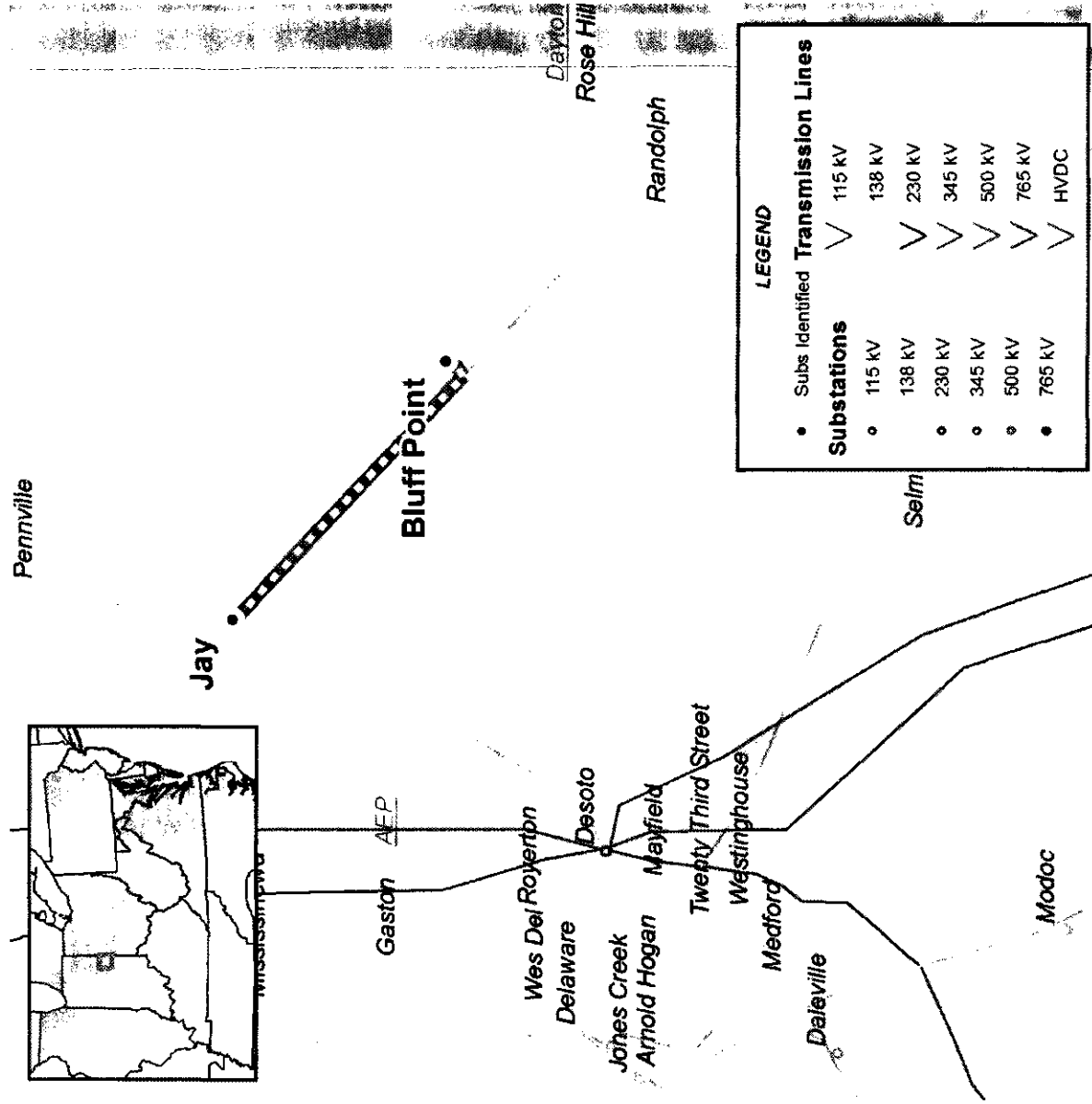
- The East Lima – New Liberty 138 kV line loads to 108.6% of its emergency rating (150 MVA) for the single contingency loss of Findlay 138 kV bus and Northeast Findlay 138 kV bus.
- Advance 2016 baseline upgrade b1868 (Perform a sag study on the 05E LIMA – New Liberty 138 kV line) to 2015.
- Estimated Project Cost: \$100 K
- New Projected in-service date: 6/1/2015.





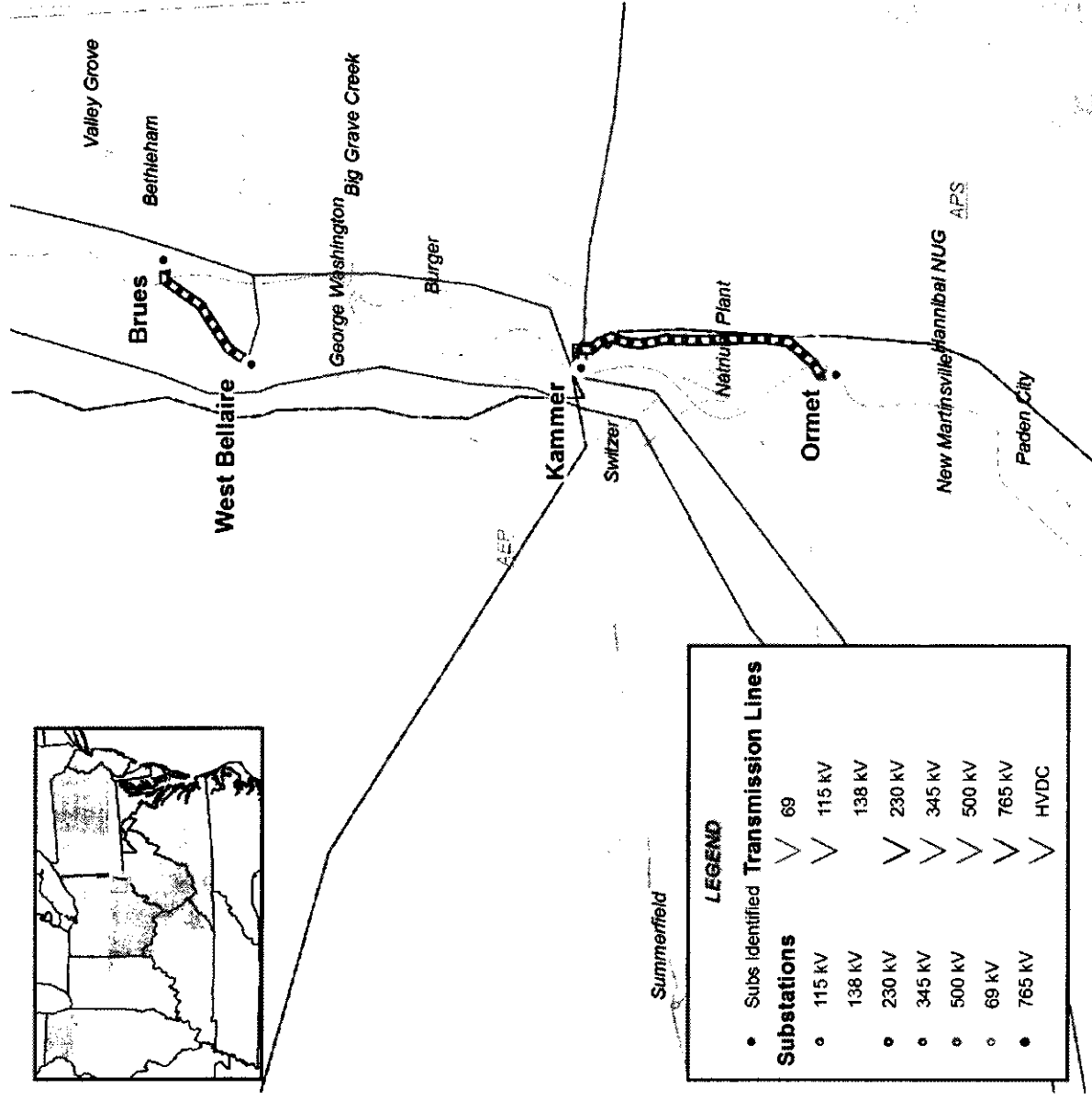
## AEP Transmission Zone Reinforcement

- Advance 2016 baseline project B1733 (Perform a sag study of the Bluff Point - Jay 138 kV line. Upgrade breaker, wavetrapp, and risers at the terminal ends).
- Expected cost is \$2,000,000.
- Projected in-service is 12/01/2014.





# AEP Transmission Zone Reinforcement

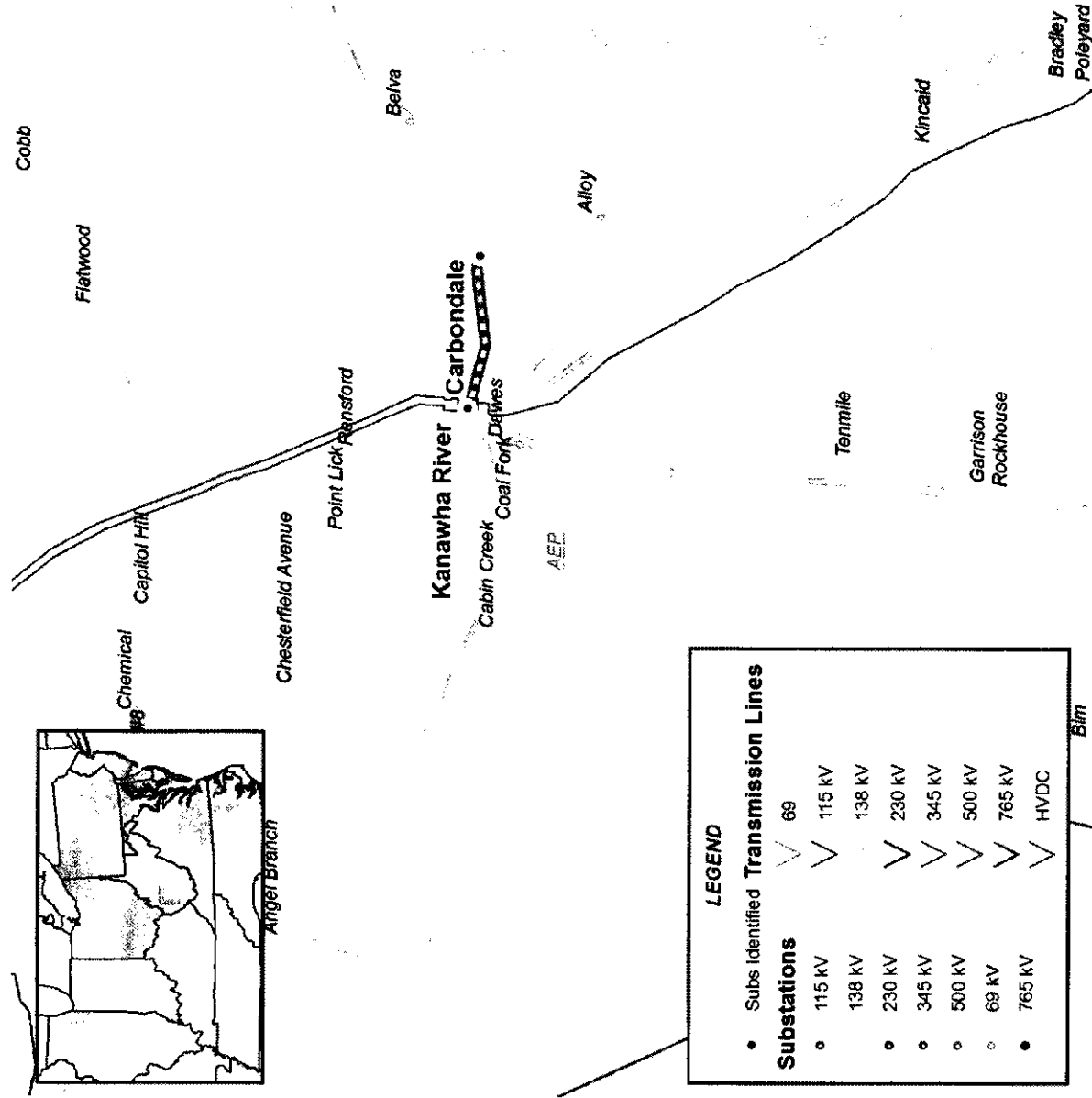


- Brues – West Bellaire 138 kV line loads to 105.5% for N-1-1: Loss of Tidd - Cardinal 138 kV line, followed by loss of Kammer 345/138 kV transformer.
- Perform a sag study on the Brues – West Bellaire 138 kV line.
- Expected cost is \$25,000.
- Projected in-service is 12/01/2014.



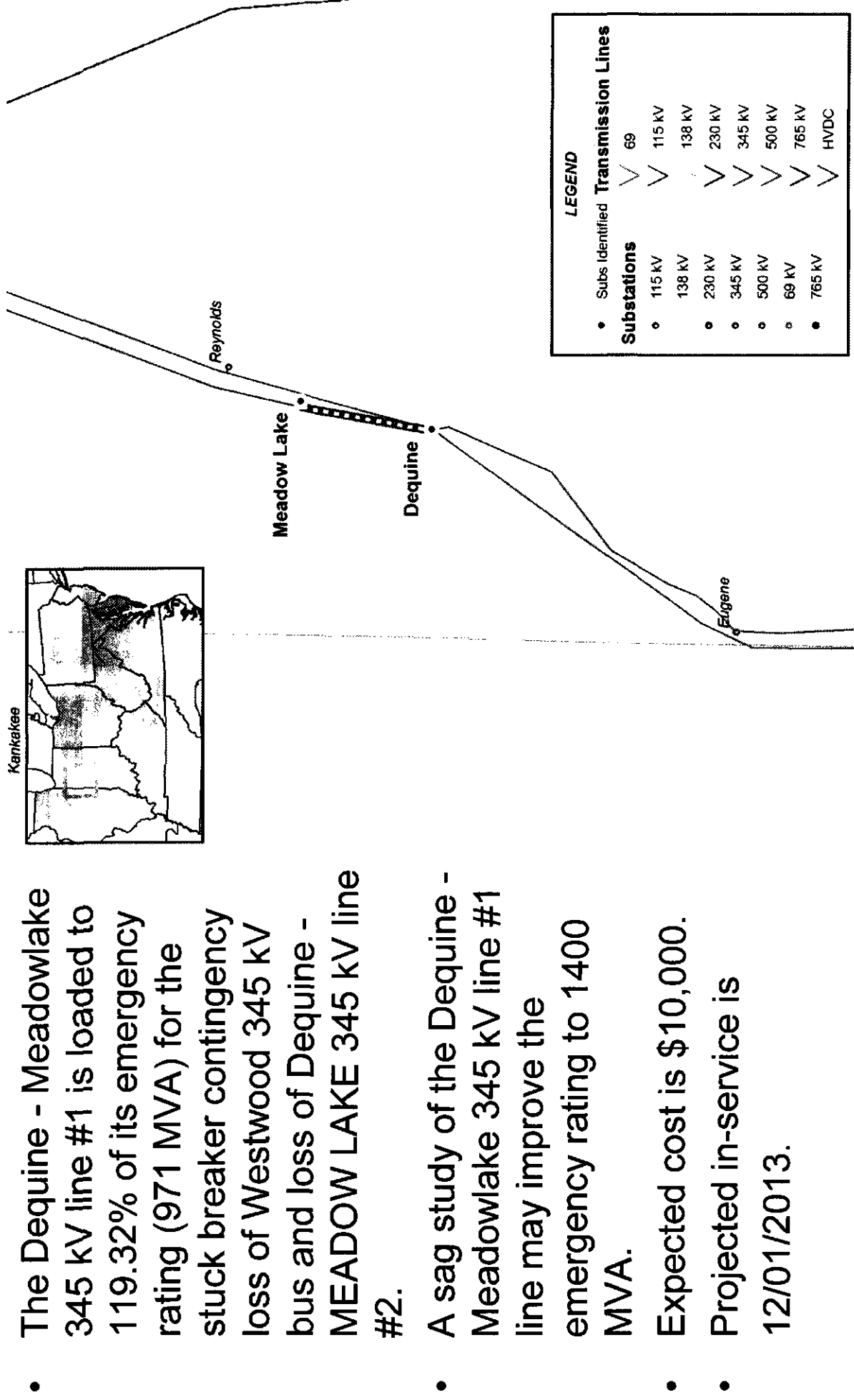
# AEP Transmission Zone Reinforcement

- Kanawha – Carbondale 138 KV line loads to 101% of Rate B for N-1-1 Loss of Hatfield – Black Oak 500 kV line, followed by loss of Mountaineer – Belmont 765 kV line.
- Advance 2016 Baseline project B1865 (Perform a Sag study on the Kanawha – Carbondale 138 KV line to see if any remedial action needed to reach the new ratings of 251/335MVA).
- Expected cost is \$70,000.
- Projected in-service is 12/01/2014.





## AEP Transmission Zone Reinforcement

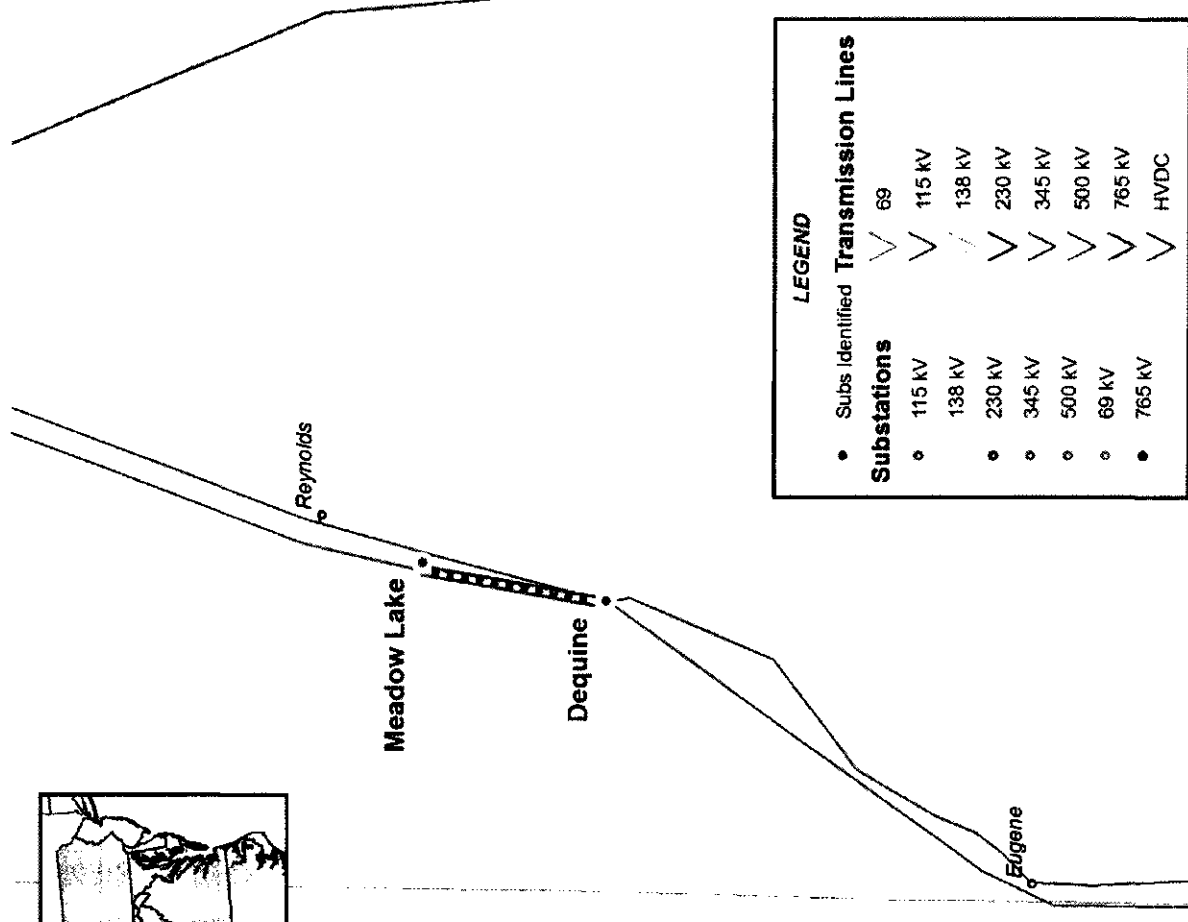
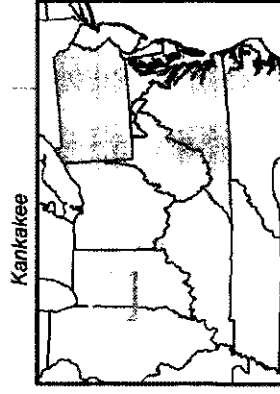


- The Dequine - Meadowlake 345 kV line #1 is loaded to 119.32% of its emergency rating (971 MVA) for the stuck breaker contingency loss of Westwood 345 kV bus and loss of Dequine - MEADOW LAKE 345 kV line #2.
- A sag study of the Dequine - Meadowlake 345 kV line #1 line may improve the emergency rating to 1400 MVA.
- Expected cost is \$10,000.
- Projected in-service is 12/01/2013.



## AEP Transmission Zone Reinforcement

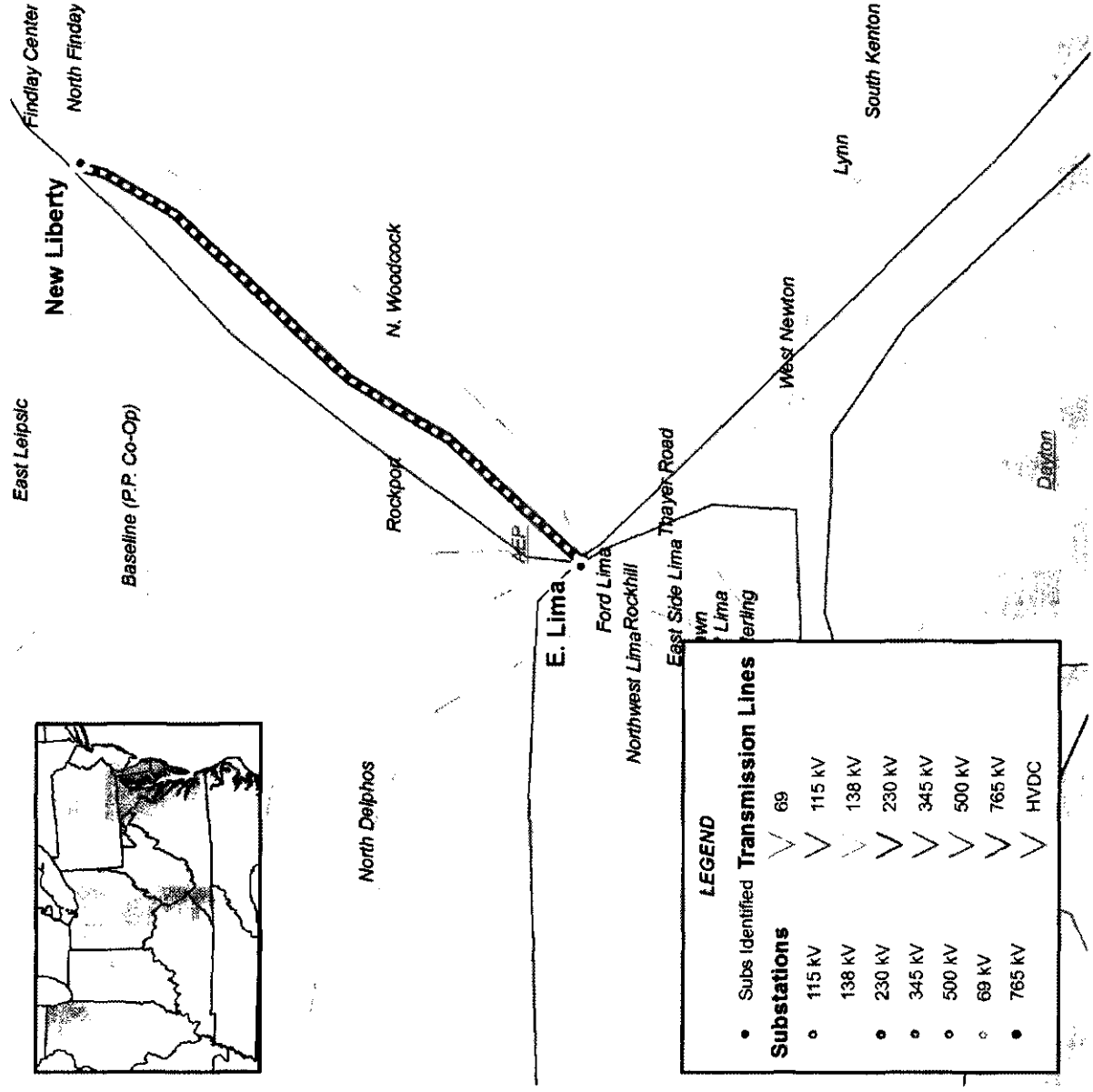
- The Dequine - Meadowlake 345 kV line #2 is loaded to 119.32% of its emergency rating (971 MVA) for the stuck breaker contingency loss of Westwood 345 kV bus and loss of Dequine - MEADOW LAKE 345 kV line #1.
- A sag study of the Dequine - Meadowlake 345 kV line #2 line may improve the emergency rating to 1400 MVA.
- Expected cost is \$10,000.
- Projected in-service is 12/01/2013.





# AEP Transmission Zone Reinforcement

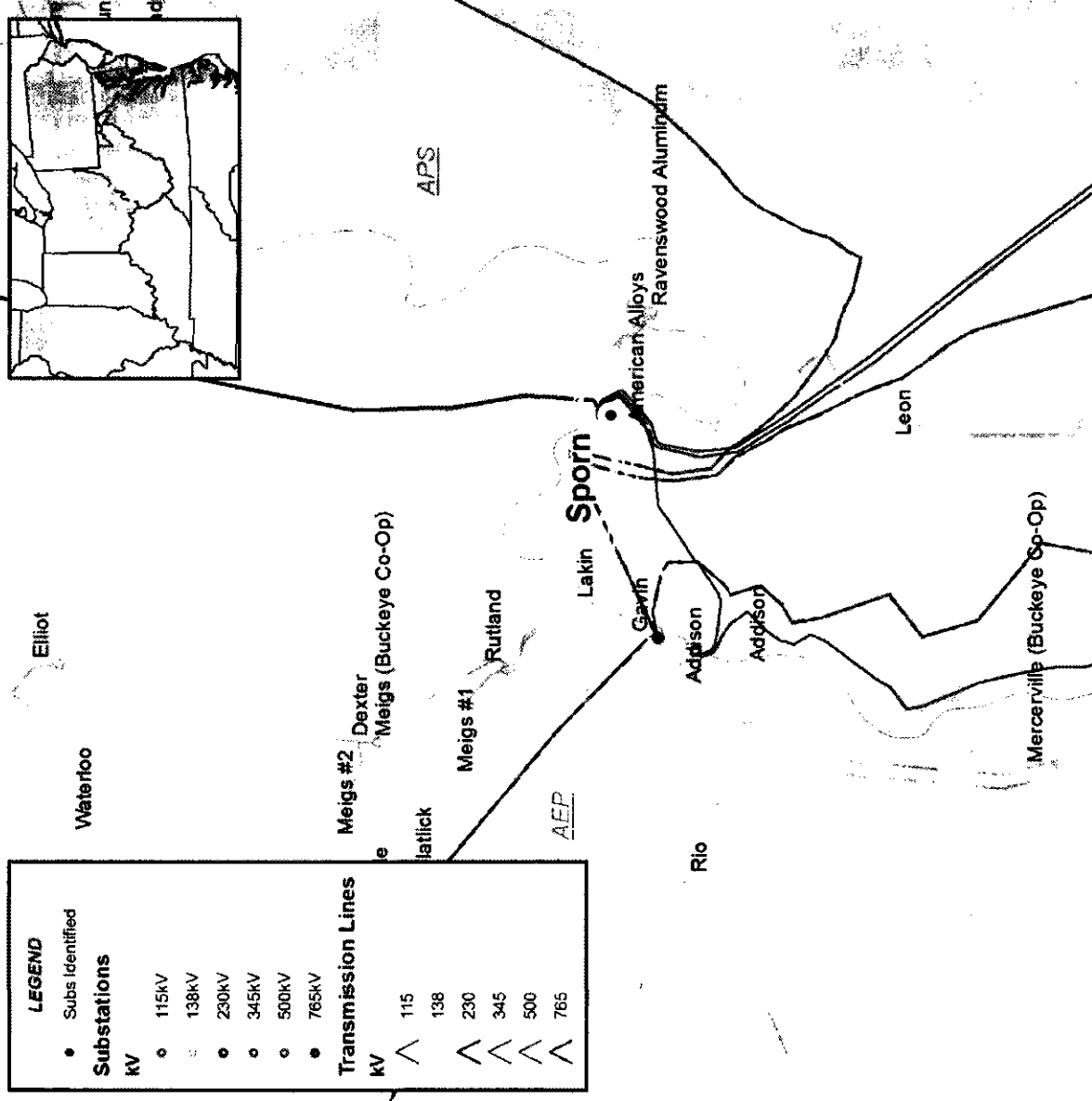
- East Lima – New Liberty 138kV line loads to 112.01% of rate B for N-1-1: Loss of Findlay 138 kV bus and NE Findlay 138 kV bus followed by loss of North Woodcock 138 kV bus.
- Advance 2016 Baseline project B1868 (Perform sag study of the East Lima – New Liberty 138kV line to see if any remedial action needed to reach the new SE rating of 219MVA).
- Estimated Project Cost: \$100K
- Projected in-service is 12/01/2014.





## AEP Transmission Zone Reinforcement

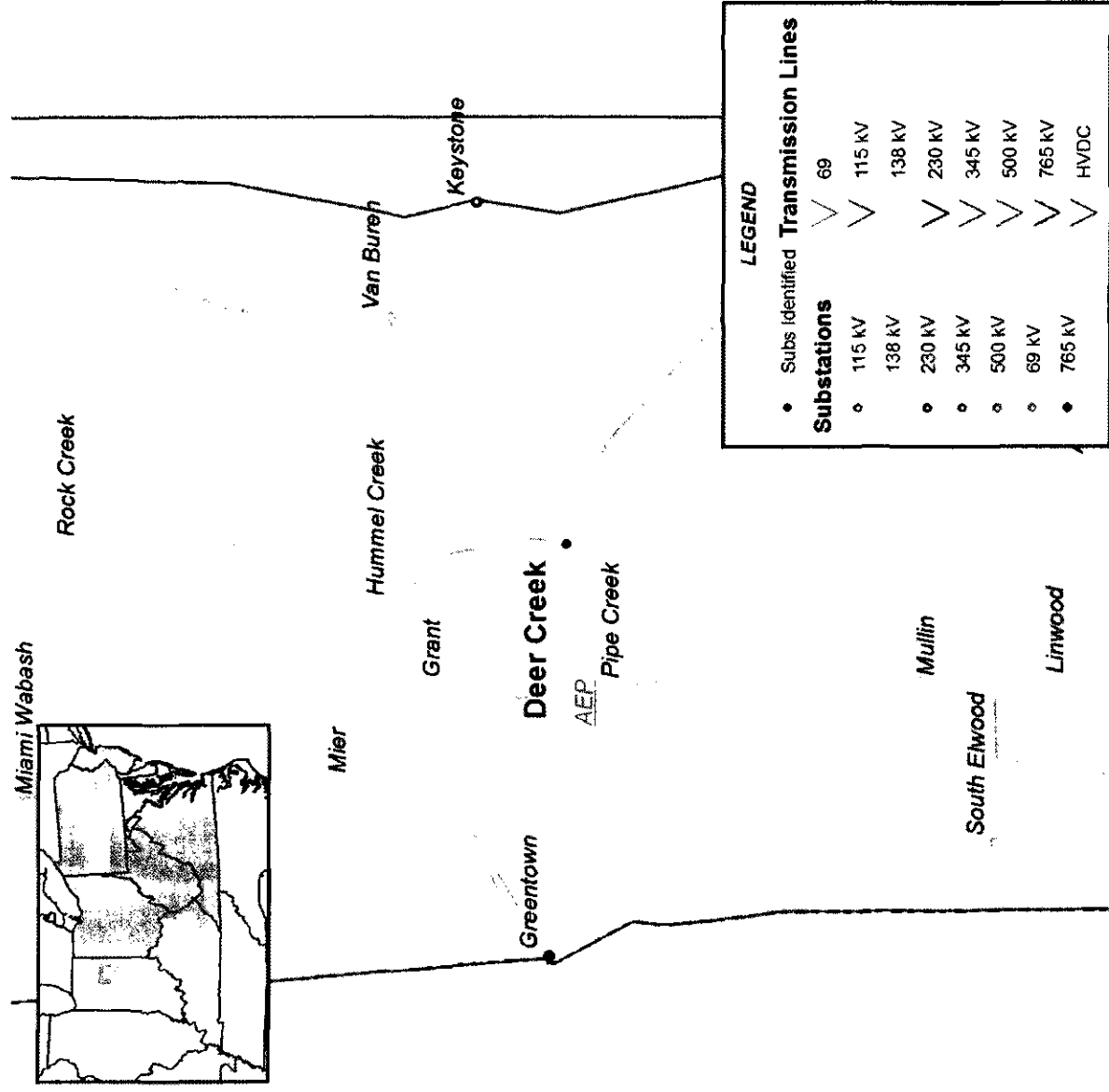
- The Mountain – Belmont 765 kV line is loaded to 108.45% for the stuck breaker contingency loss of Marysville – Sorenson 765 kV line and Marysville – Flatlick 765 kV line.
- Establish a new 765/345 interconnection at Sporn. Sporn is located approximately  $\frac{3}{4}$  mile away from Mountaineer 765 kV station. Install a 765/345 kV transformer at Mountaineer and build  $\frac{3}{4}$  mile of 345 kV to Sporn.
- Estimated Project Cost: \$65 M
- Projected in-service is 6/01/2015.





## AEP Transmission Zone Reinforcement

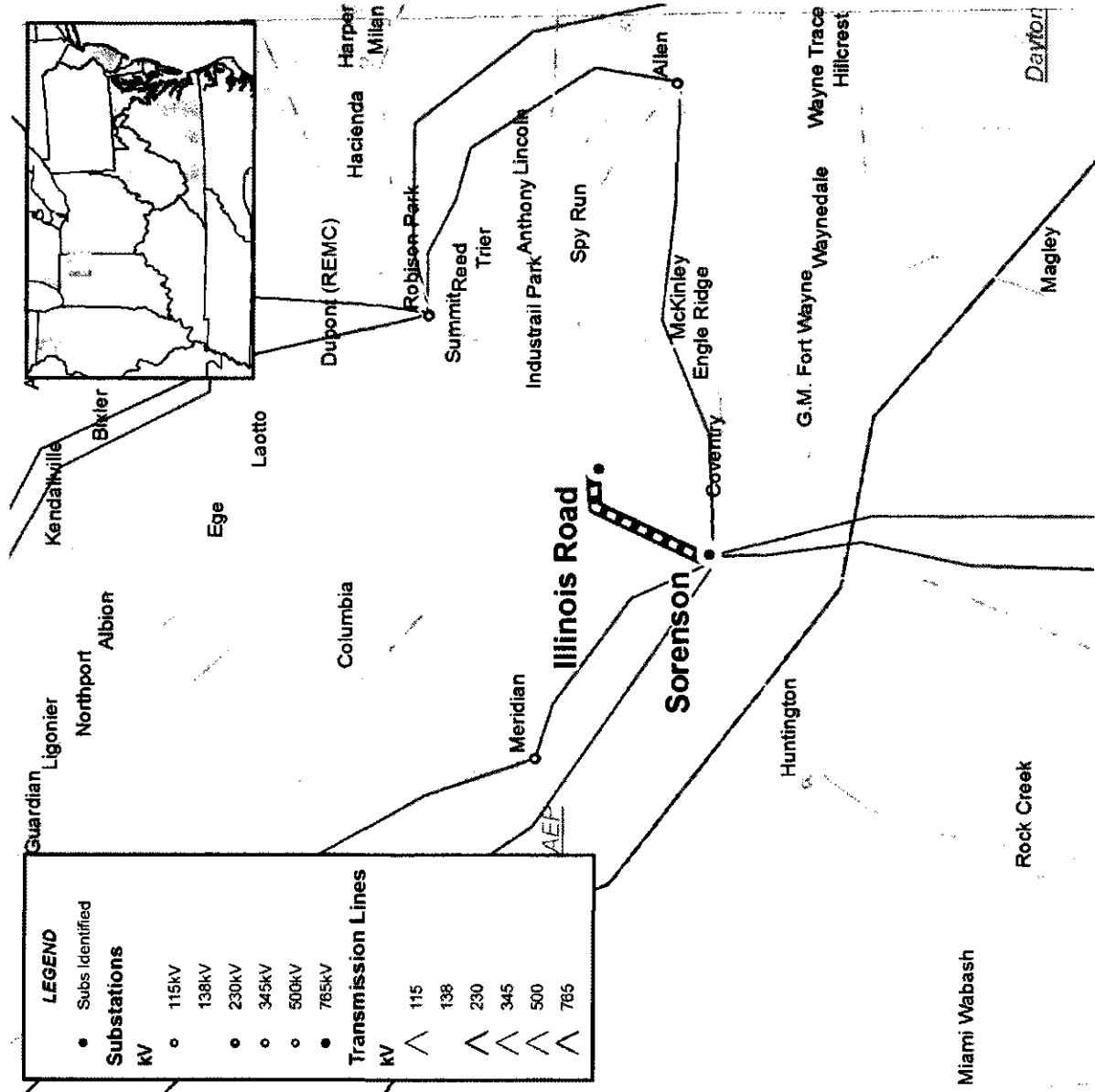
- The Grant Tap – Deer Creek 138 kV line is loaded to 115.87% of its emergency rating (223 MVA) for the stuck breaker contingency loss of Greentown 138 kV bus and Dumont – Greentown 765 kV line.
- Perform a sag study on the Grant Tap – Deer Creek 138 kV line and replace bus and risers at Deer Creek station.
- Estimated Project Cost: \$300 K
- Projected in-service is 12/01/2014.





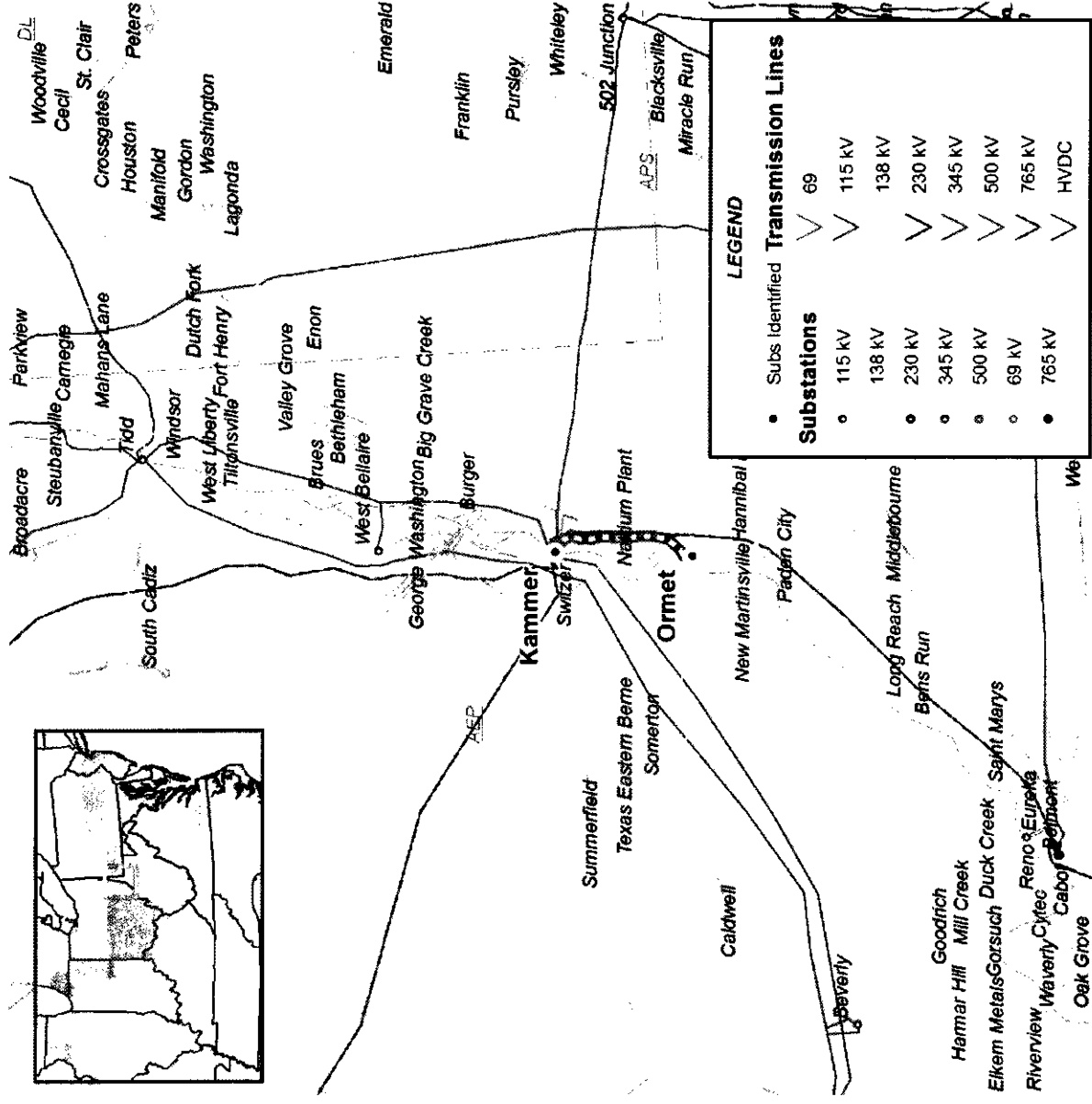
## AEP Transmission Zone Reinforcement

- Sorenson - Illinois Road  
138kV loads to 102.7% of  
Rate A for N-1-1: Loss of  
Allen - Sorenson 345 kV  
line and Allen 345/138 kV  
transformer + BASE CASE
- Advance Baseline project  
B1436 (Perform a sag study  
on the Sorenson - Illinois  
Road 138kV line to increase  
the emergency MOT for this  
line. Replace bus and risers  
at Illinois Road).
- Estimated Project Cost: \$20  
K
- Projected in-service is  
12/01/2014.





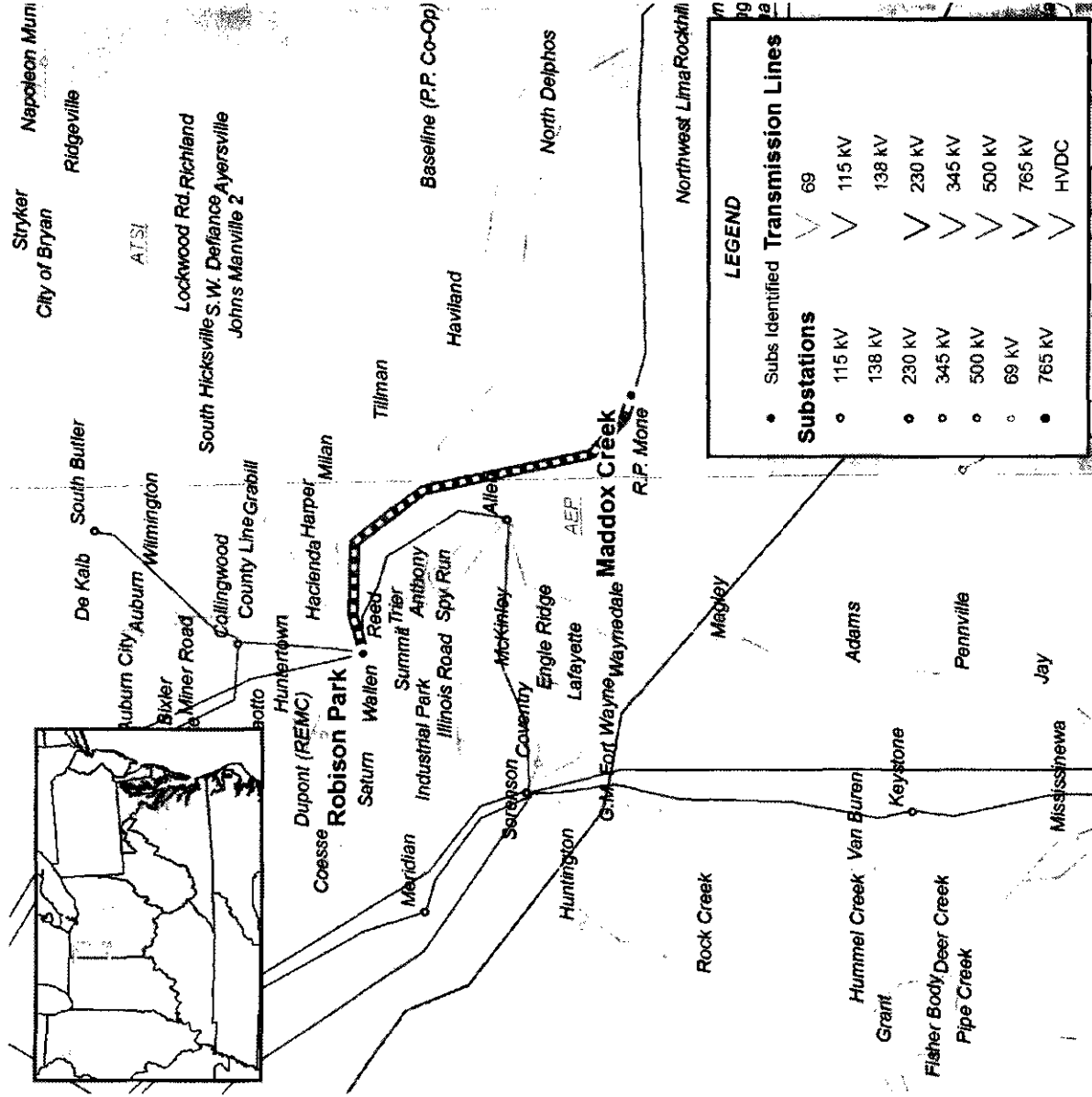
# AEP Transmission Zone Reinforcement



- The Kammer – Ormet 138 kV line is loaded to 100.1% of its emergency rating (296 MVA) for tower contingency loss of West Bellaire – Tidd 345 kV line and West Bellaire – Kammer 345 kV line.
- Perform a sag study on the Kammer – Ormet 138 kV line of the conductor section.
- Estimated Project Cost: \$100K
- Projected in-service is 12/01/2012.



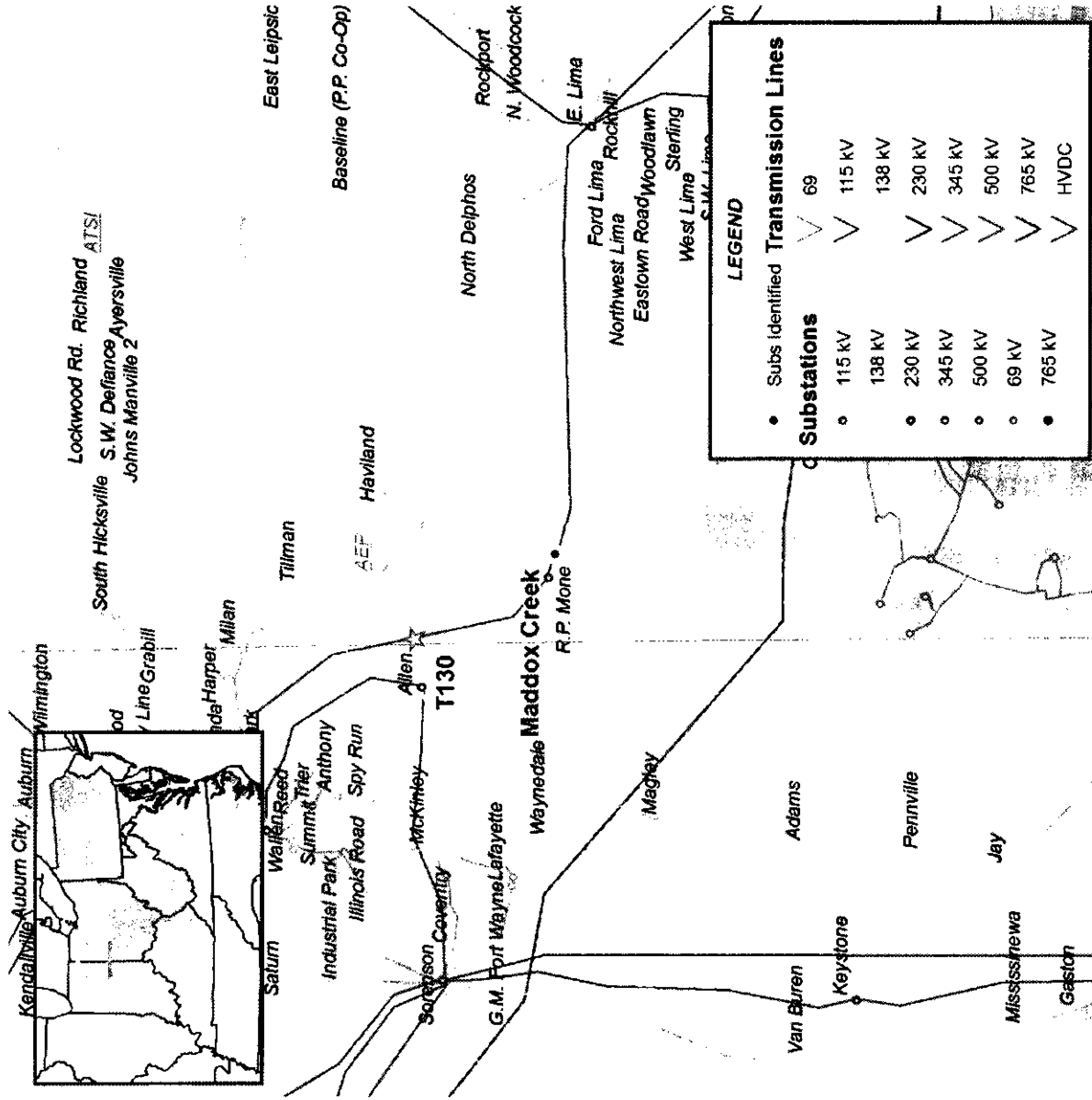
# AEP Transmission Zone Reinforcement



- The Maddox - Convooy 345 kV line is loaded to 109.01% of its emergency rating (897 MVA) for the stuck breaker
- contingency loss of SW Lima – E Lima 345 kV line and SW Lima 345/138 kV transformer #2.
- Perform a sag study of the Maddox- Convooy 345 kV line to improve the emergency rating to 1400 MVA.
- Estimated Project Cost: \$30 K
- Projected in-service is 12/01/2013.



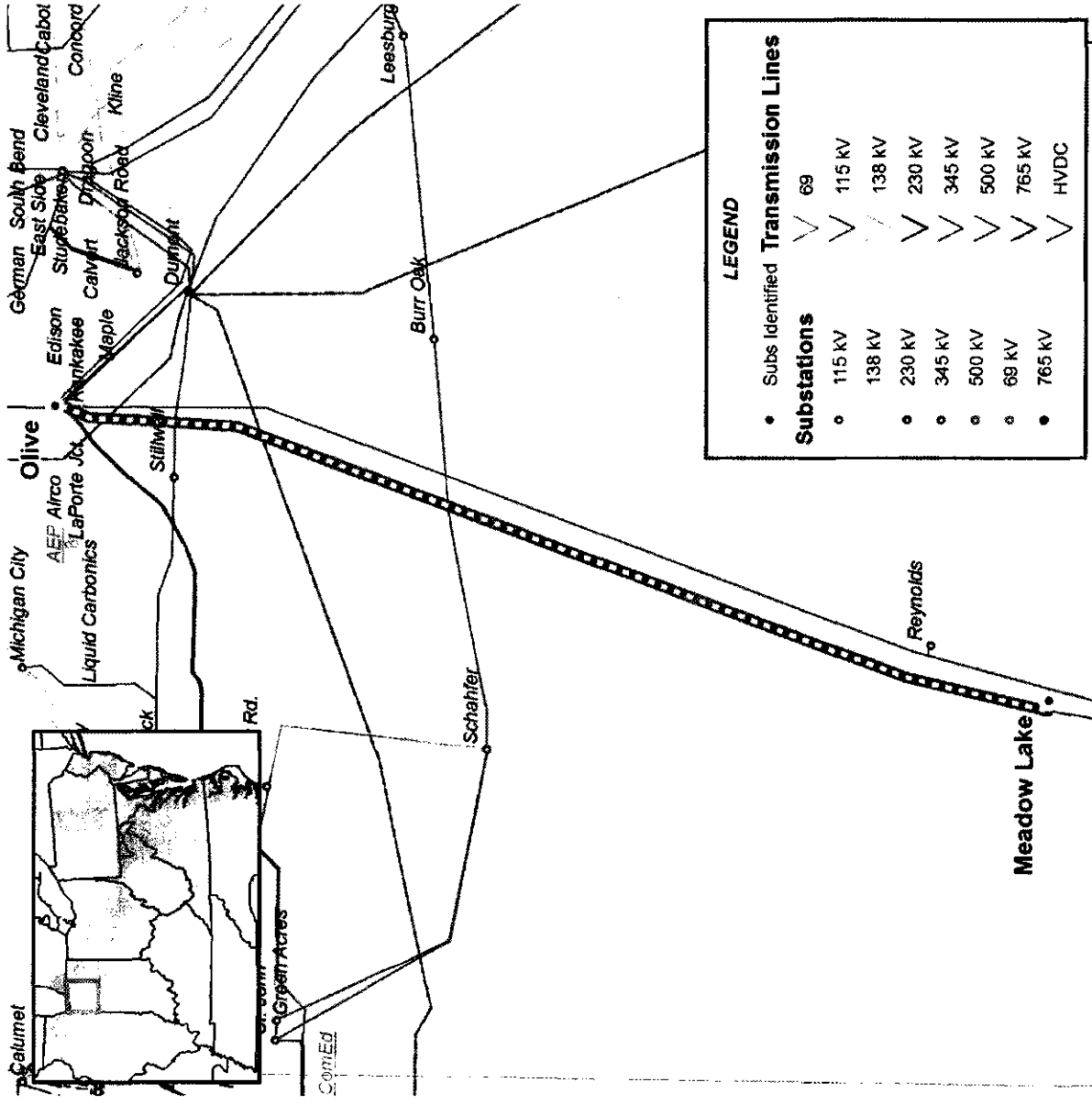
# AEP Transmission Zone Reinforcement



- The Maddox – T130 345 kV line is loaded to 121.81% of its emergency rating (897 MVA) for the tower contingency loss of the Allen – Sorenson 345 kV line and Convoy – Robison Park 345 kV line.
- Perform a sag study of the Maddox – T130 345 kV line to improve the emergency rating to 1400 MVA.
- Estimated Project Cost: \$30 K
- Projected in-service is 12/01/2013.



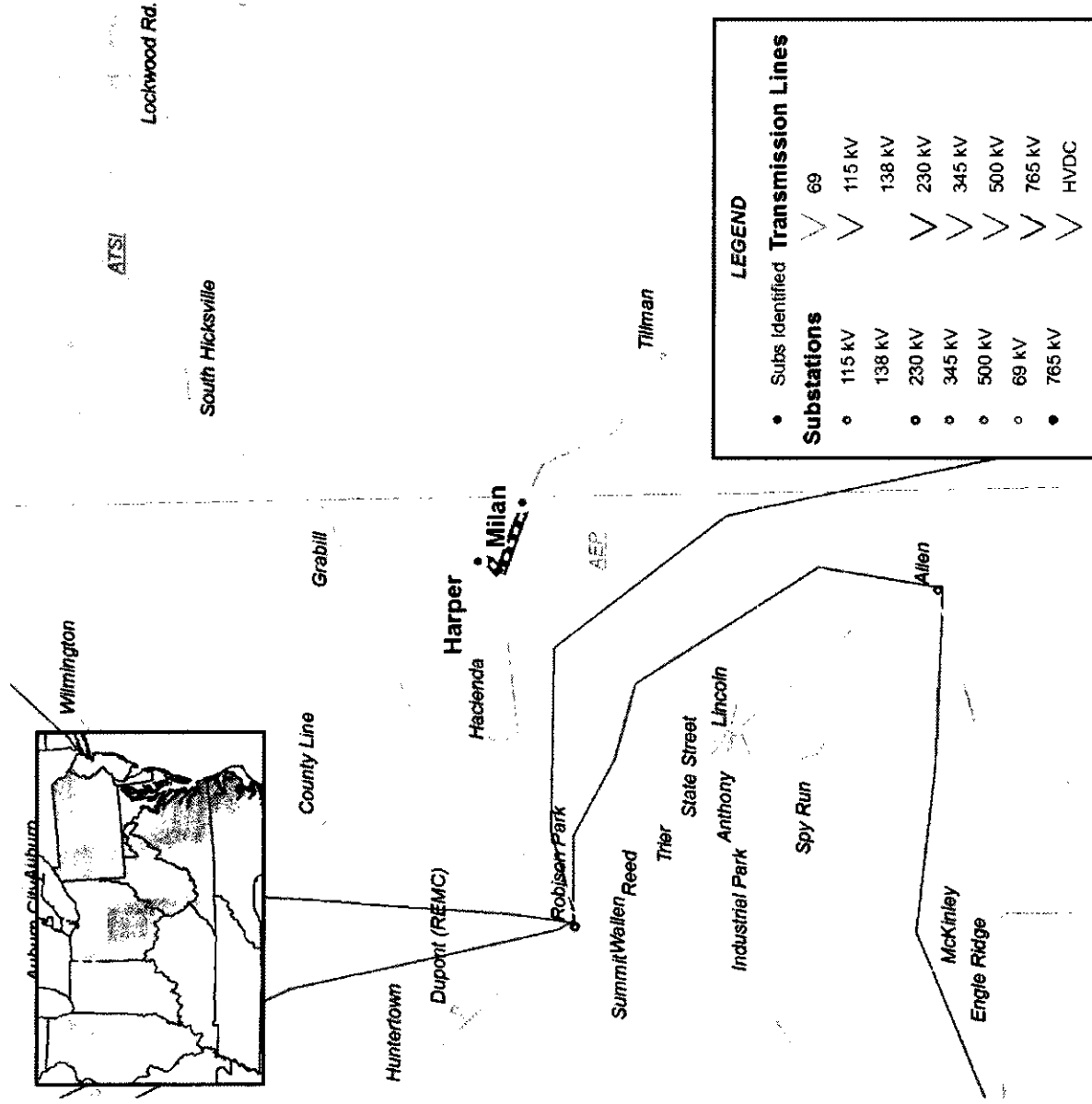
## AEP Transmission Zone Reinforcement



- The Meadowlake – Olive 345 kV line is loaded to 103.1% of its emergency rating (971 MVA) for the bus contingency loss of the Reynolds 345 kV bus.
- Perform a sag study of the Meadowlake - Olive 345 kV line to improve the emergency rating to 1400 MVA.
- Estimated Project Cost: \$60 K
- Projected in-service is 12/01/2013.



# AEP Transmission Zone Reinforcement

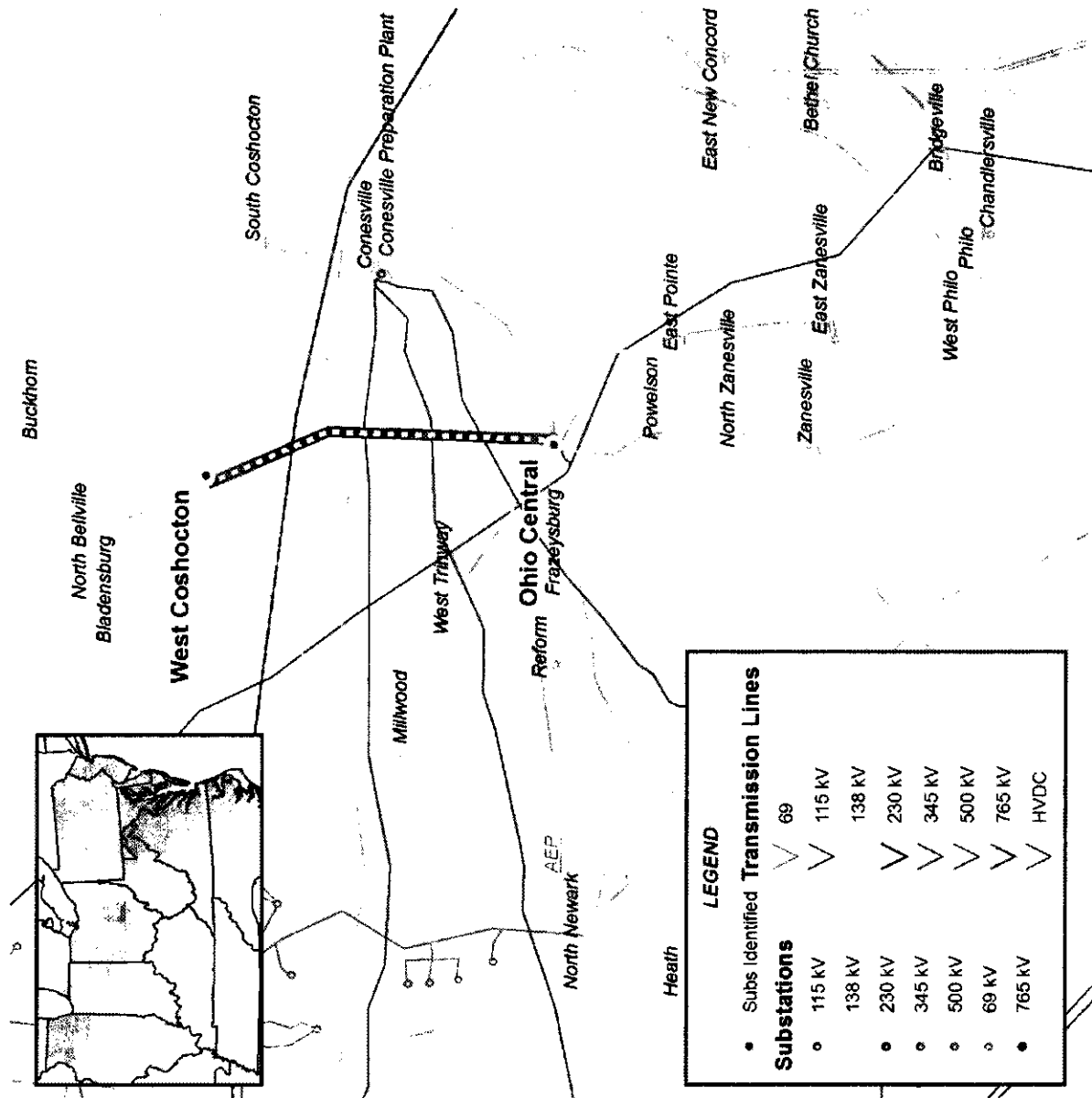


- The Milan – Harper 138 kV line is loaded to 100.57% of its emergency rating (183 MVA) for the tower contingency loss of East Side – N Delphos 138 kV line and East Side – Sterling 138 kV line.
- Perform a sag study on the Milan - Harper 138 kV line and replace bus and switches at Milan Switch station.
- Estimated Project Cost: \$350 K
- Projected in-service is 12/01/2014.



# AEP Transmission Zone Reinforcement

- Advance 2016 Baseline project B1871 (Perform a sag study on the Ohio Central – West Coshocton 138KV line).
- Estimated Project Cost: \$75 K
- Projected in-service is 12/01/2014.

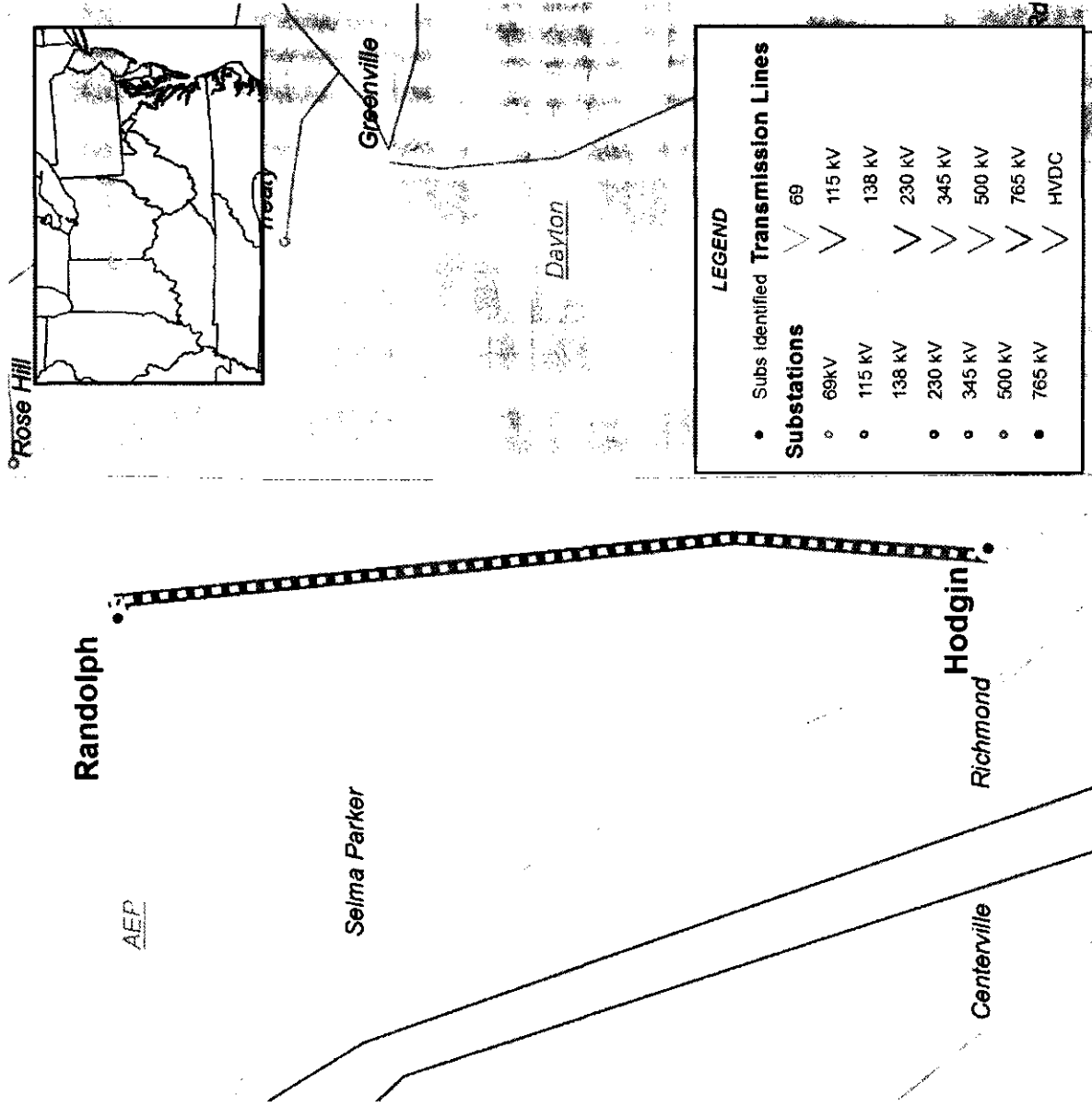






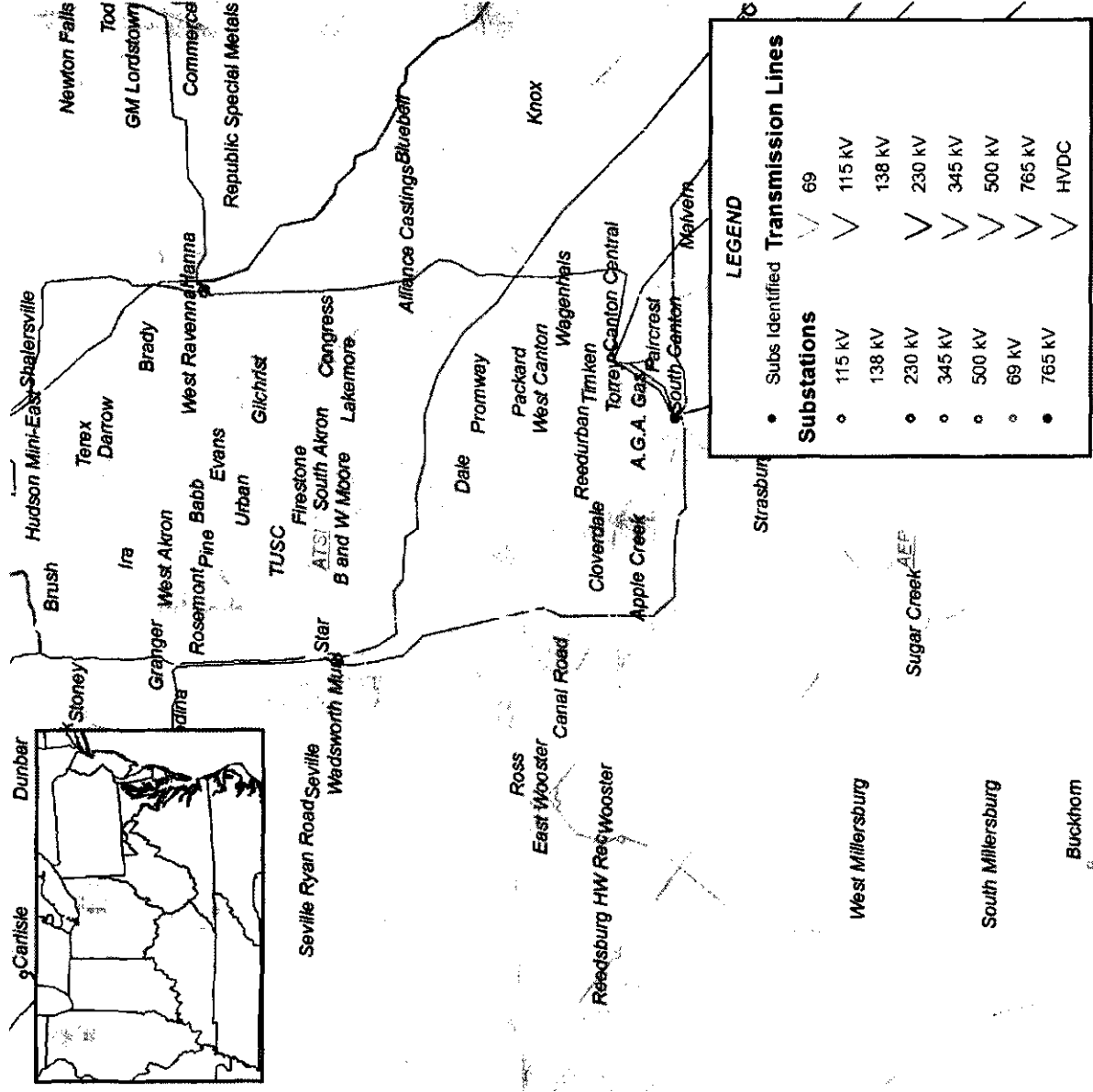
## AEP Transmission Zone Reinforcement

- Advance 2016 Baseline project B1734 (Perform a sag study of Randolph - Hodgins 138 kV line. Upgrade terminal equipment).
- Estimated Project Cost: \$20 K
- Projected in-service is 12/01/2014.





# AEP Transmission Zone Reinforcement



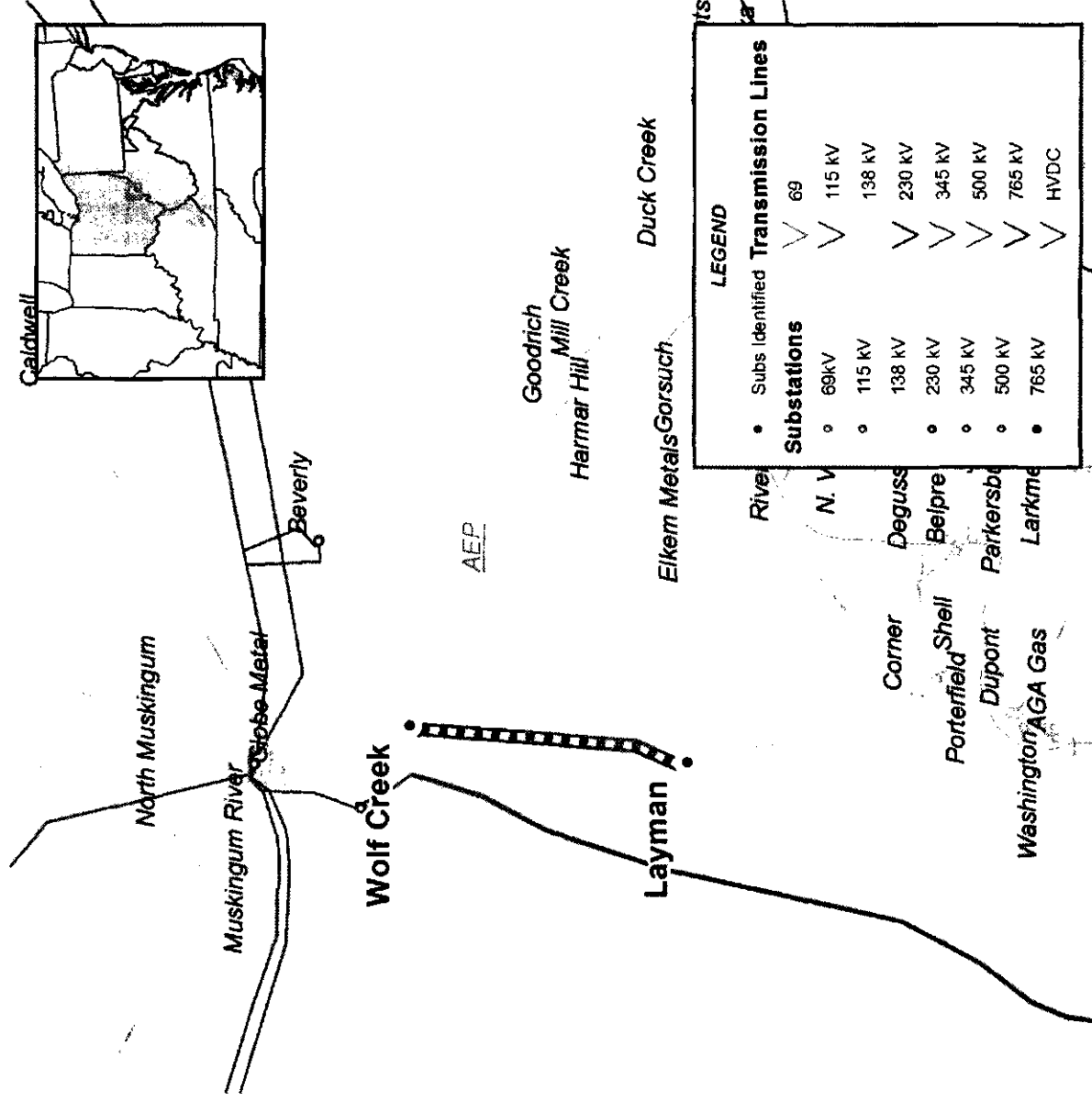
- South Canton – Harmon 345 kV line Advance 2016 Baseline project B1812 (rebuild AEP portion of line). Also upgrades risers, wavetrap and bus work at South Canton station. Expected rating is 1800 MVA S/N and 1800 MVA S/E.
- Estimated Project Cost: \$2 M
- Projected in-service is 6/1/2015.





## AEP Transmission Zone Reinforcement

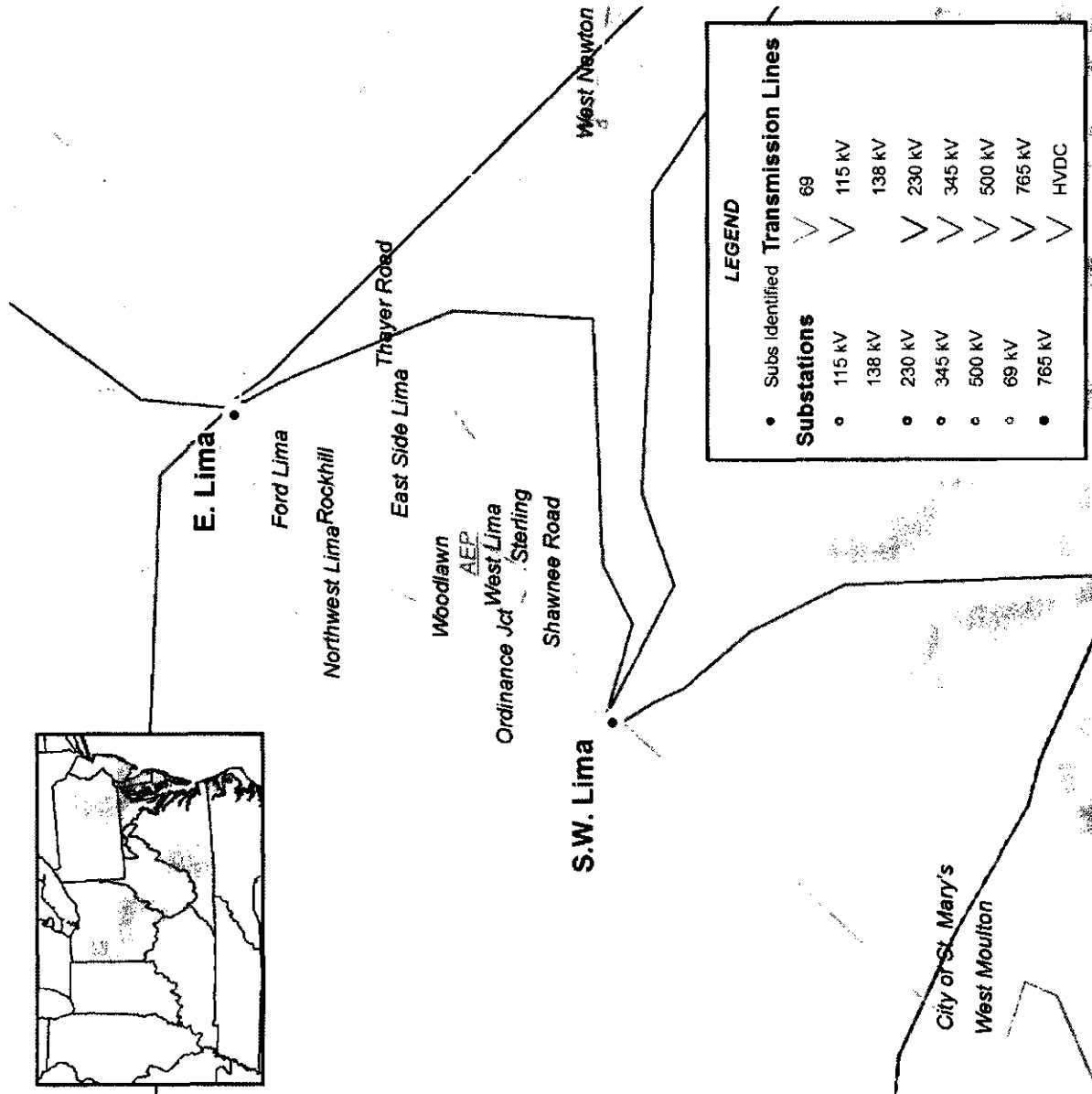
- Advance 2016 Baseline project B1738 (Perform a sag study of the Wolf Creek - Layman 138 kV line. Upgrade terminal equipment including a 138 kV breaker and wavetrap).
- Estimated Project Cost: \$2 M
- Projected in-service is 12/01/2014.





# AEP Transmission Zone Reinforcement

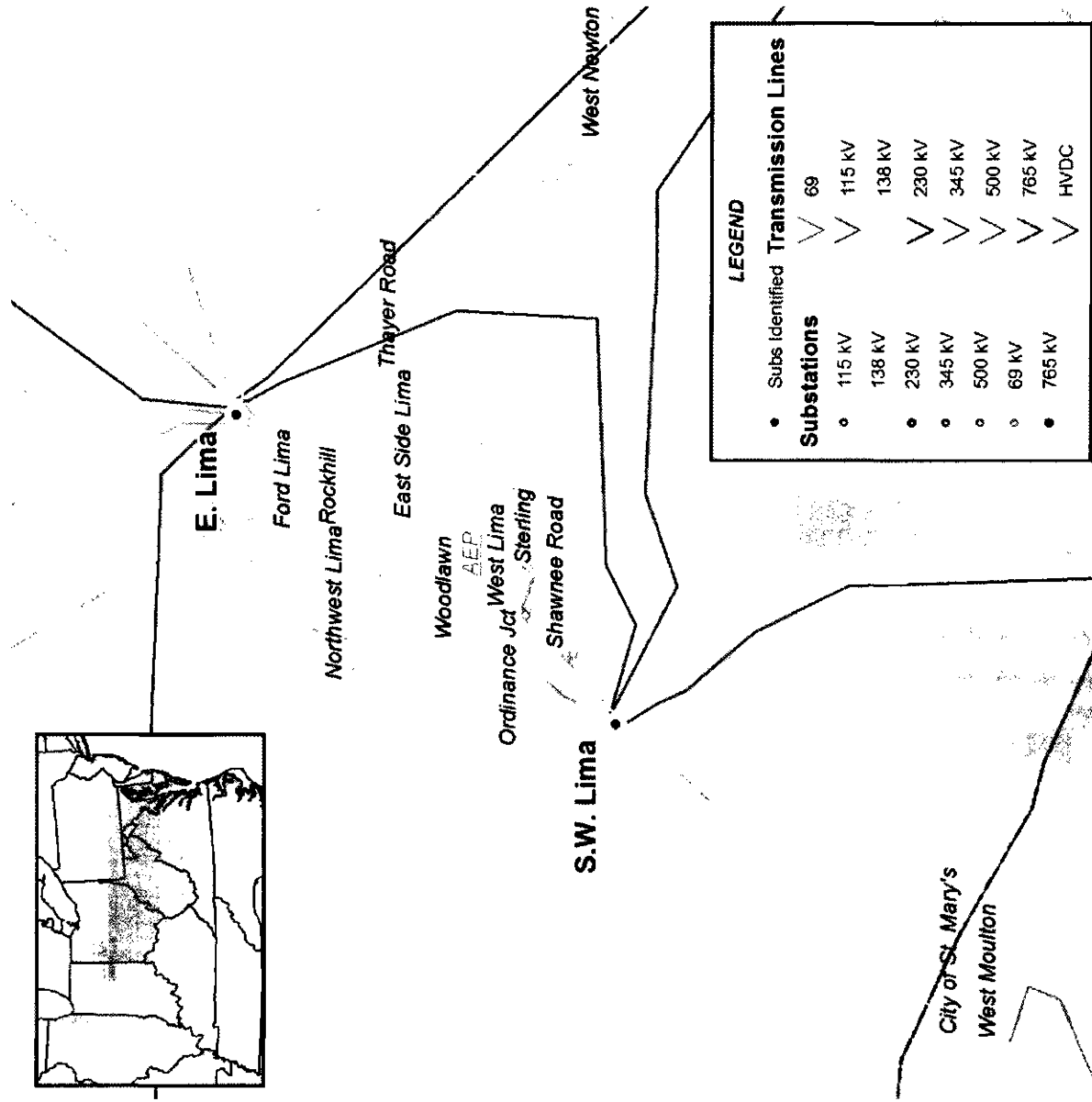
- Advance 2016 Baseline project B1883 (Switch the breaker position of transformer #1 and SW Lima at East Lima 345 kV bus).
- Estimated Project Cost: \$1 M
- Projected in-service is 6/01/2014.





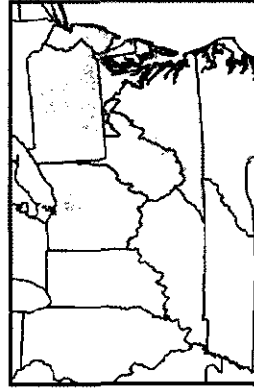
## AEP Transmission Zone Reinforcement

- The SW Lima 345/138 kV transformer loads to 103.04% of its emergency rating (551 MVA) for the stuck breaker contingency loss of SW Lima – E Lima 345 kV line and SW Lima 345/138 kV transformer #2.
- Terminate Transformer #2 at SW Lima in a new bay position. Today a breaker failure results in outage of Transformer #2 and SW Lima – East Lima 345 kV line. As a result two facilities are lost due to a common mode outage. Improve the switching will change this contingency to an N-1-1 event.
- Estimated Project Cost: \$5 M
- Projected in-service is 12/01/2014.

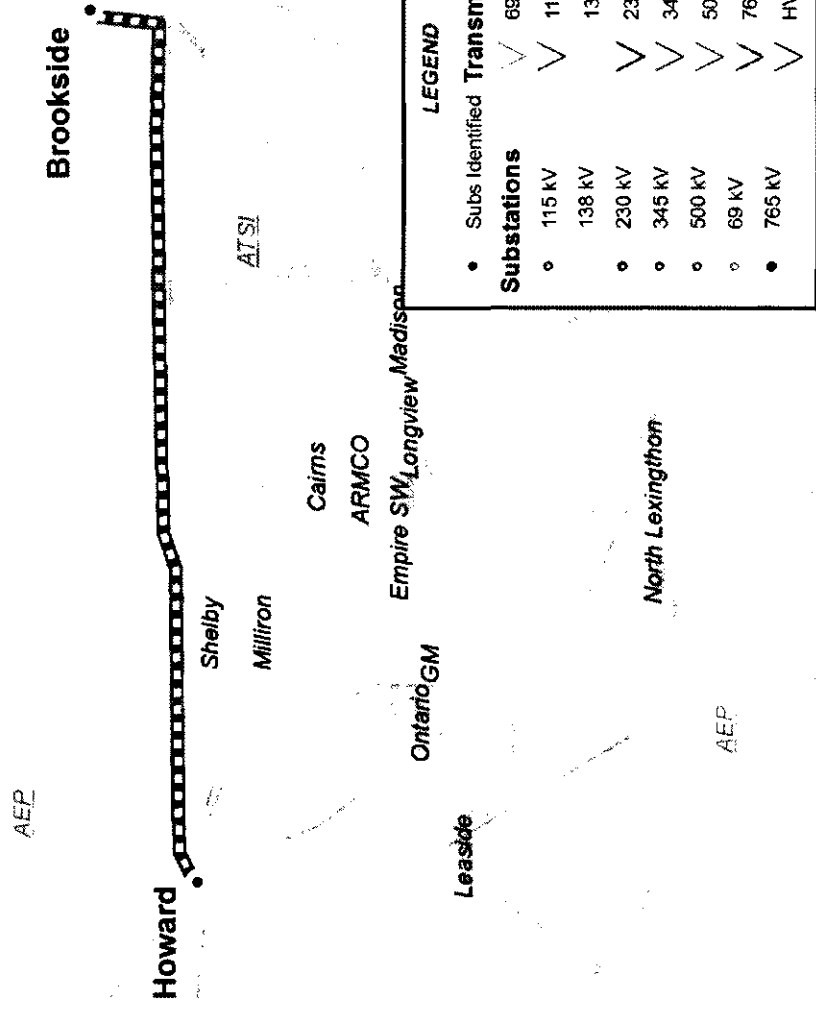




## AEP Transmission Zone Reinforcement



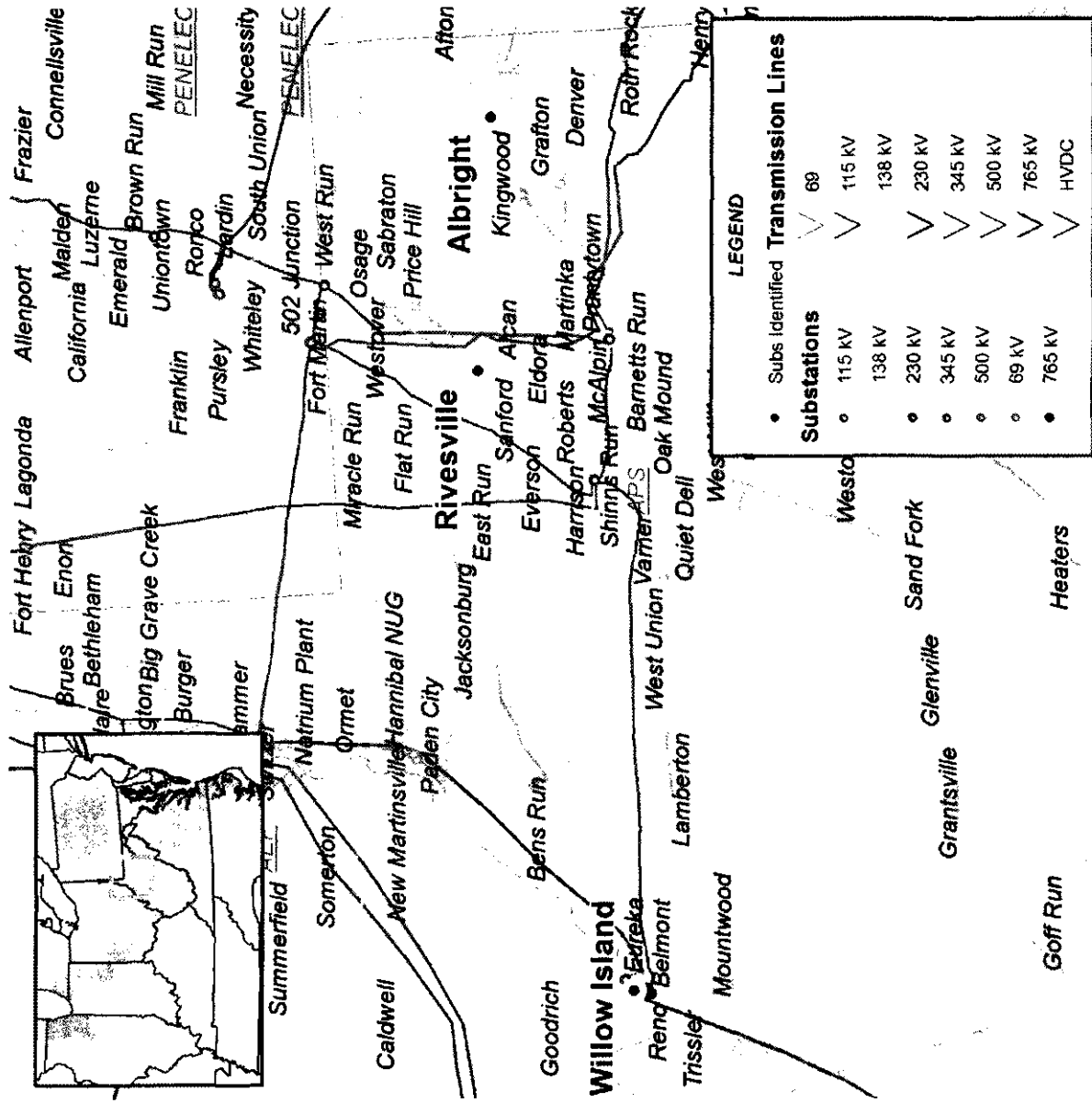
- The Brookside - Howard 138 kV line loads to 114.96% of its emergency rating (173 MVA) for the tower contingency loss of the Galion - Leaside 138 kV line and Galion - General Motors Corp 138 kV line.
- Perform a sag study on the Brookside - Howard 138 kV line and replace bus and risers at AEP Howard station.
- Estimated Project Cost: \$500 K
- Projected in-service is 12/01/2014.





# FES (APS) Deactivations

- Albright 1, 2, & 3;  
Rivesville 5 & 6; Willow  
Island 1 & 2
- Requested deactivation  
date: 9/1/2012





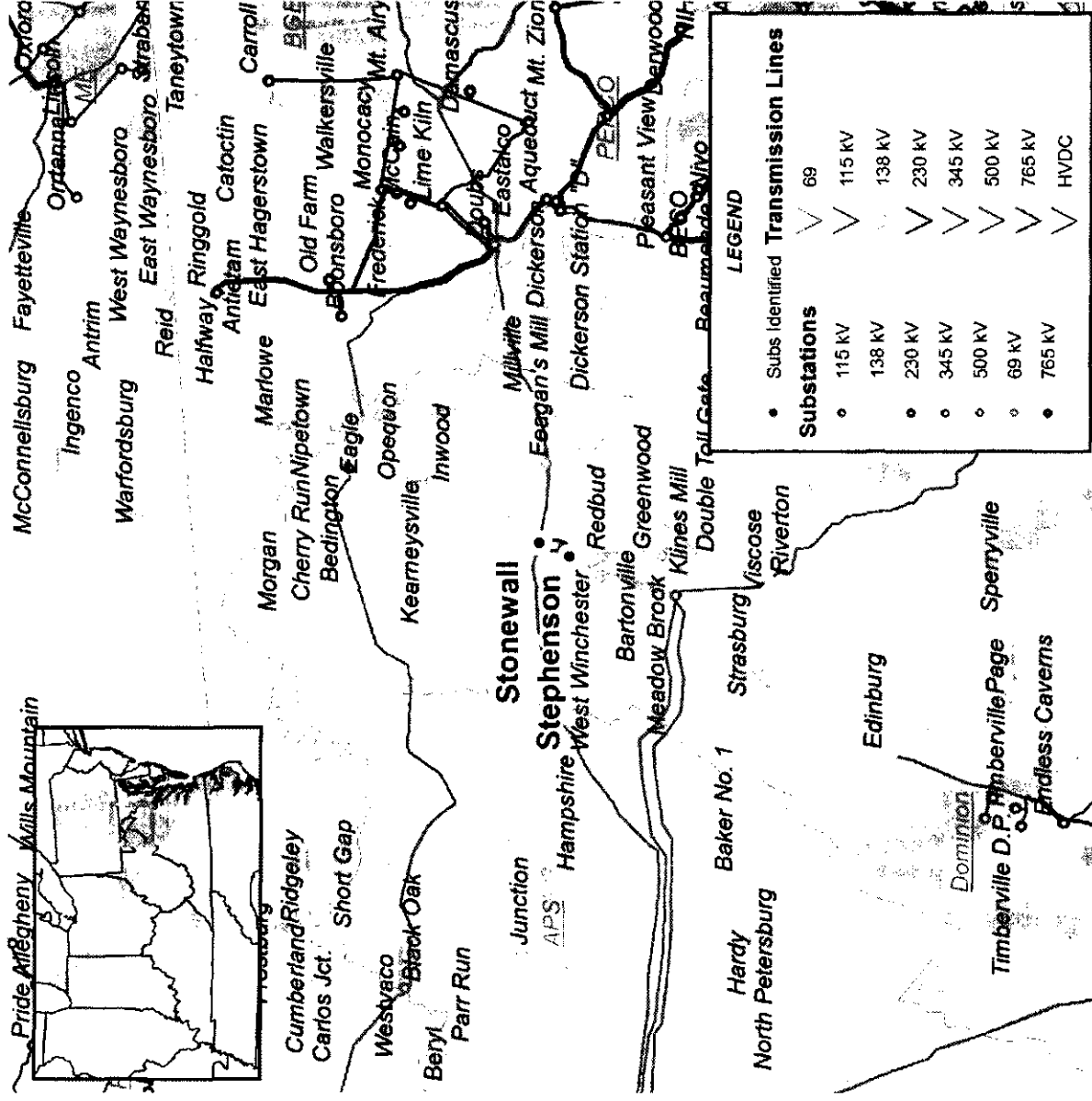
# FES (APS) Deactivations

- These deactivations aggravate the loadings on the Stonewall - Stephenson 138 kV line previously identified for Armstrong 1 & 2; Ashtabula 5; Bayshore 2-4; Eastlake 1-5; Lake Shore 18; R Paul Smith 3 & 4

- Replace line trap at Stonewall on the Stephenson 138 kV line terminal (existing base line upgrade b1902)

- Estimated Project Cost: \$0.075M

- Projected in-service date: 6/1/2013

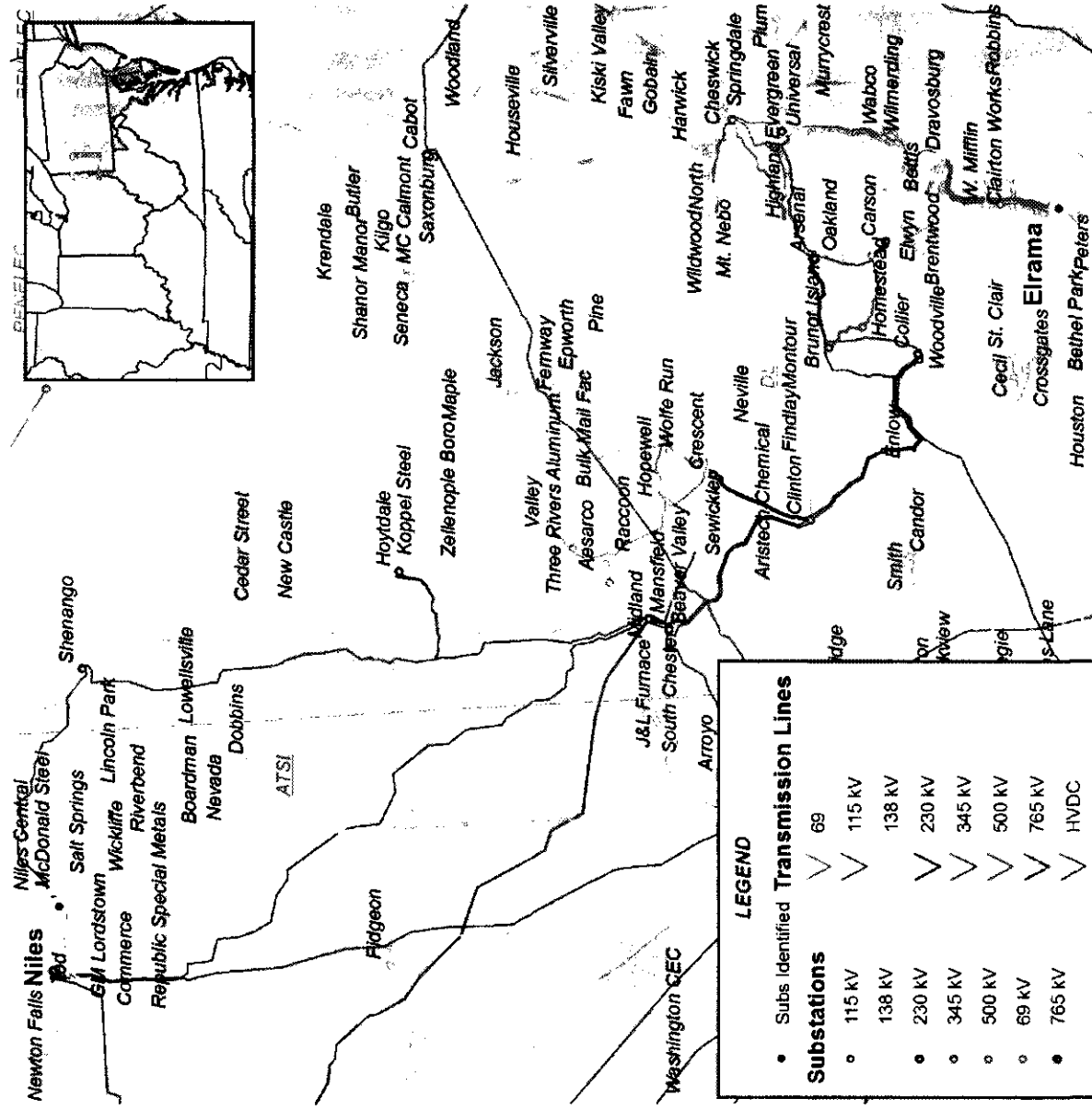


# GenOn Deactivations



# GenOn Deactivations

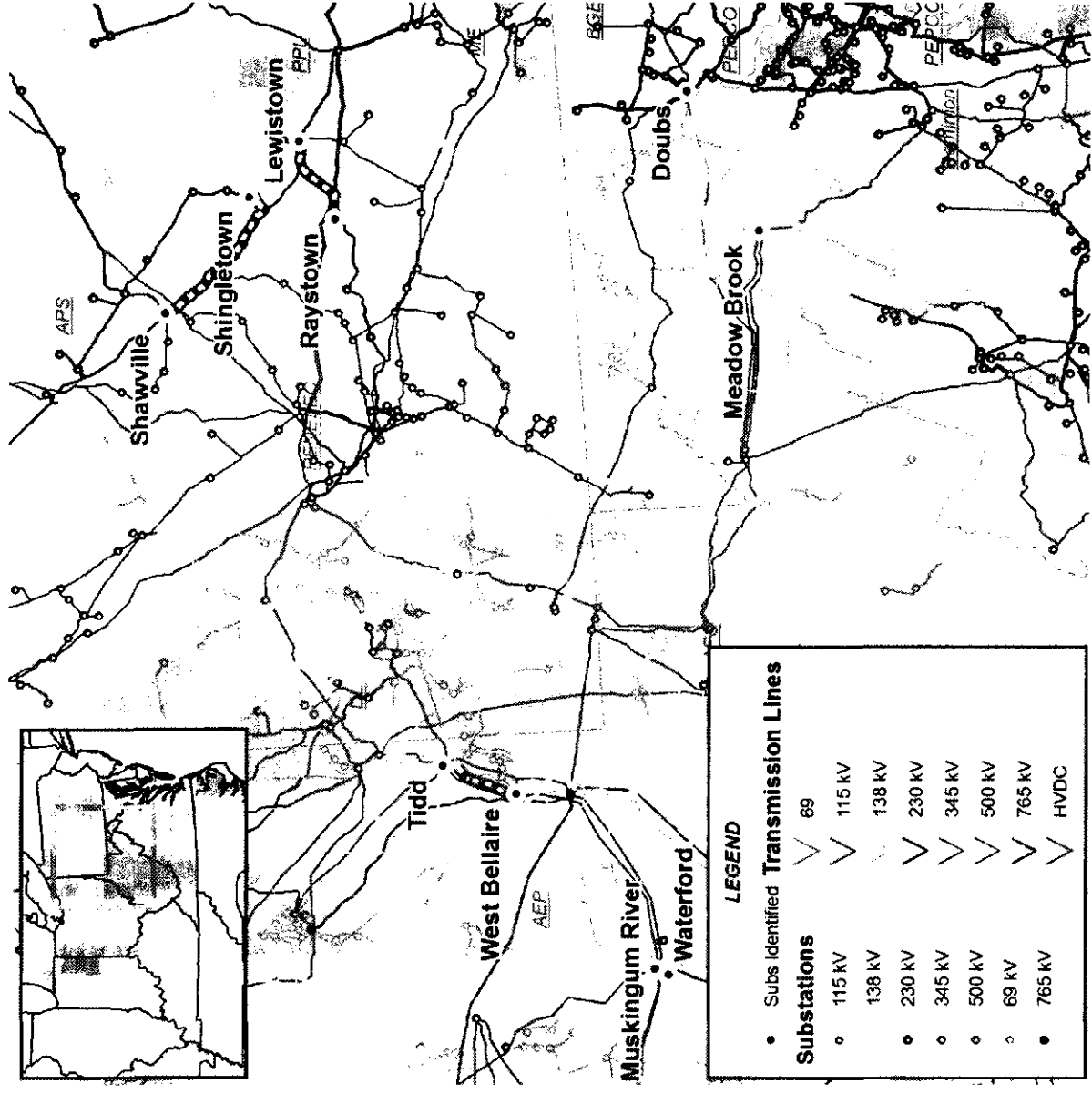
- Niles 1 & 2; Elrama 1, 2, 3 & 4
- Requested deactivation date: 6/1/2012





# GenOn Deactivations

- Criteria violations
  - N-1 Voltage
  - N-1 Thermal
  - N-1-1 Voltage Magnitude and Drop
  - N-1-1 Thermal
  - Generation Deliverability
- Multiple 138kV thermal and voltage violations
- Meadow Brook & Doubbs 500kV low voltage
- Waterford-Muskingum River 345kV thermal
- West Bellaire-Tidd 345kV thermal
- Raystown-Lewistown 230kV thermal
- Shawville-Shingleton 230kV thermal
- Required upgrades shown on the following slides





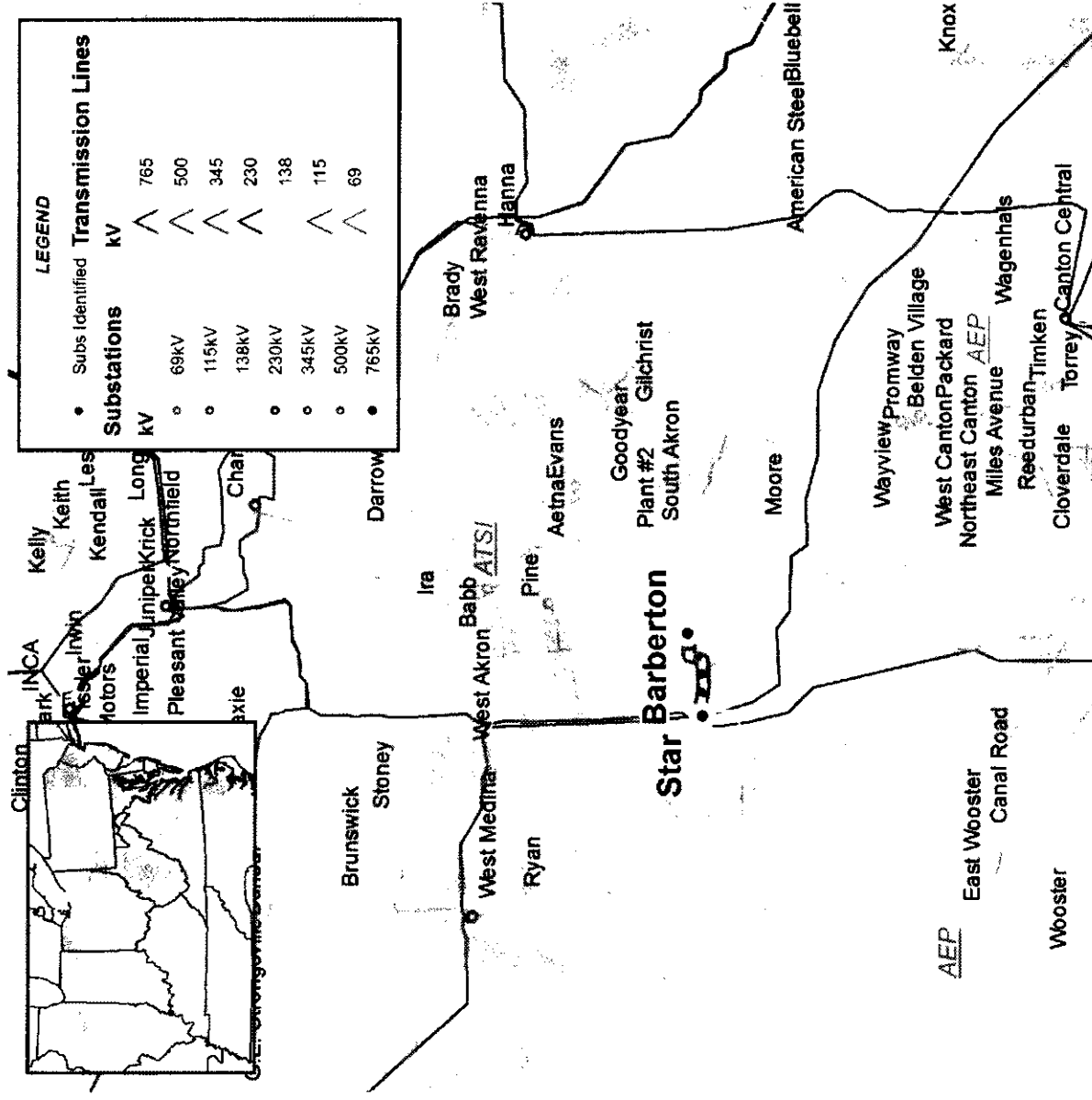
- 





# ATSI Transmission Zone Reinforcement

- N-1-1: The Barberton - Star 138kV line loads to 104.3% of its rating of 206 MVA for the single contingency loss of Star - Cloverdale 138 kV line followed by the loss of Star - Barberton 138 kV line #2.
- Replace Barberton - Star 138 kV #1 wavetrapp, CFZ relay, and line exit conductor at Barberton (existing upgrade b1285)
- Estimated Project Cost: \$0.08M
- Projected in-service date: 6/1/2012



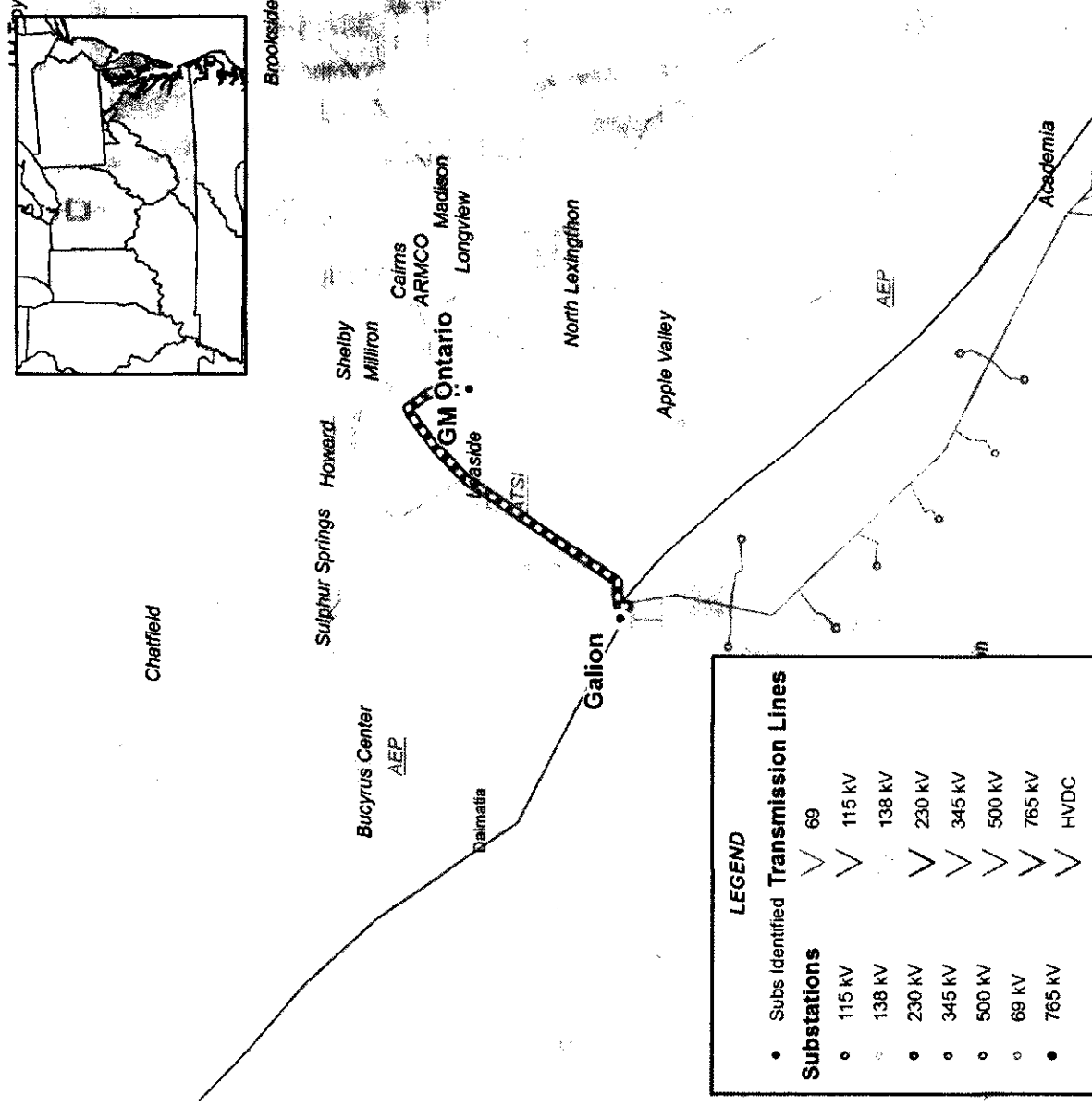
- 
- LEGEND**
- | Substations       | Transmission Lines |
|-------------------|--------------------|
| • Subs Identified | 69                 |
| ○ 69KV            | 115 KV             |
| ○ 115 KV          | 138 KV             |
| ○ 138 KV          | 230 KV             |
| ○ 230 KV          | 345 KV             |
| ○ 345 KV          | 500 KV             |
| ○ 500 KV          | 765 KV             |
| ○ 765 KV          | HVDC               |

- Previously identified for Armstrong 1 & 2; Ashtabula 5; Bayshore 2-4; Eastlake 1-5; Lake Shore 18; R Paul Smith 3 & 4
- Common Mode Outage Procedure: Star 345kV B-12 breaker Failure, Star B-8 138kV breaker Failure, Barberton-Star 138kV + Cloverdale-Star 138kV TWL, results in thermal overloads on Star 345-138kV TR #1 101%, Star-Barberton #1 106%, and Star-Barberton #2 103%
- Create a new Harmon 345/138/69 kV substation by looping in the Star – South Canton 345 kV line
- Estimated Project Cost: \$46M
- Projected in-service date: 6/1/2015



## ATSI Transmission Zone Reinforcement

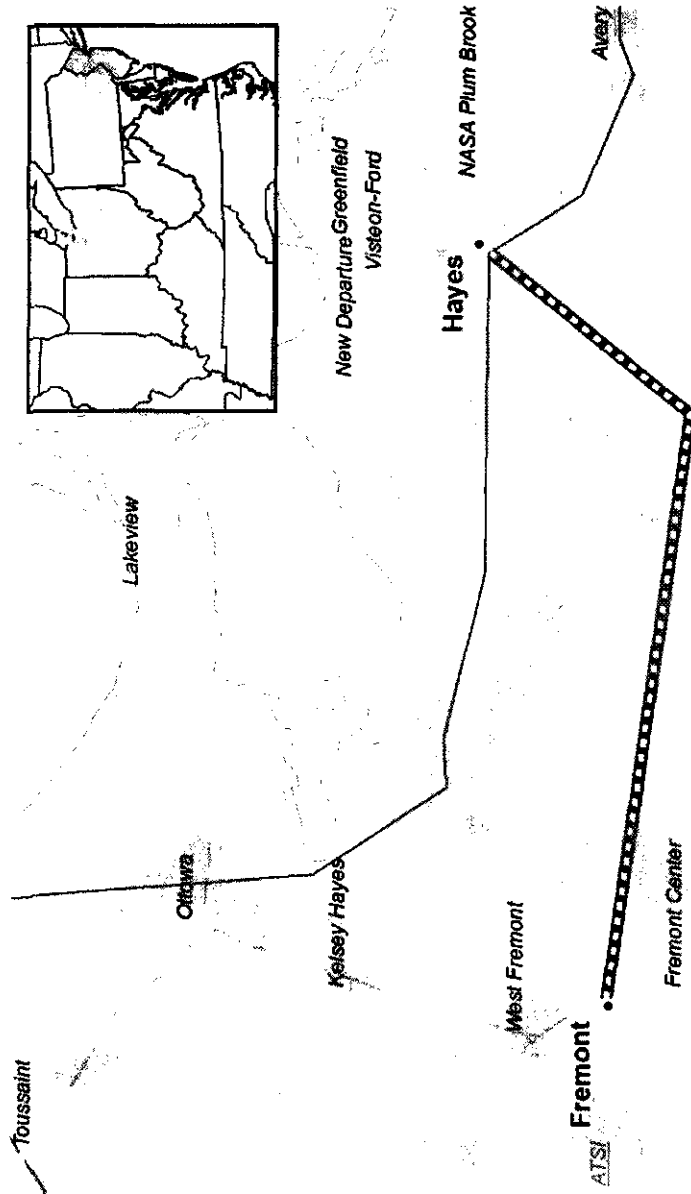
- The Gallion - Gen. Motors Corp Cpc Group ckt 1 138/138kV line loads to 105.88% of its rating of 225 MVA for the tower contingency loss of Brookside – Howard 138 kV line and Brookside – Milliron 138 kV line.
- Gallion - Gen. Motors Corp Cpc Group - Ontario line: Remove loop to Gen. Motors Corp Cpc Group substation (existing base line upgrade b1585)
- Estimated Project Cost: \$0.05M
- Projected in-service date: 6/1/2012 (Advance from 6/1/2016)





# ATSI Transmission Zone Reinforcement

- The Ottawa – Lakeview 138 kV line is loaded to 123.66% for the tower contingency loss of DAVIS BESSE-BEAVER and DAVIS BESSE-HAYES 345 KV lines.
- The Lakeview - Greenfield 138 kV line is loaded to 118.08% for the tower contingency loss of DAVIS BESSE-BEAVER and DAVIS BESSE-HAYES 345 KV lines.
- Build a new West Fremont-Groton-Hayes 138kV line
- Estimated Project Cost: \$45M
- Projected in-service date: 6/1/2018
- Short term: Existing Operating Procedure to open Lakeview-Greenfield from 6/1/2012 through 6/1/2018

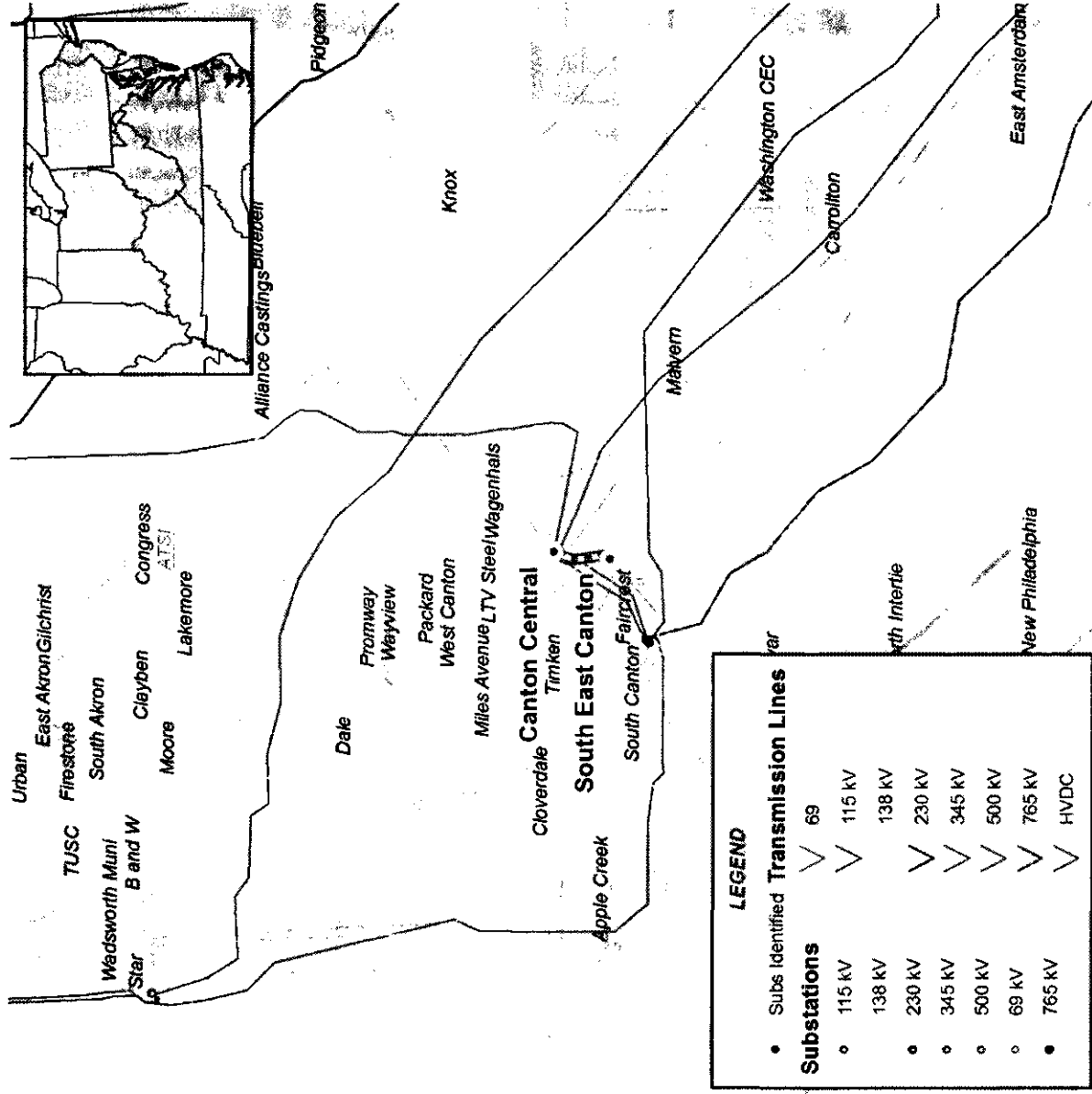


| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| • 115 kV          | 69                 |
| • 138 kV          | 115 kV             |
| • 230 kV          | 138 kV             |
| • 345 kV          | 230 kV             |
| • 500 kV          | 345 kV             |
| • 69 kV           | 500 kV             |
| • 765 kV          | 765 kV             |
|                   | HVDC               |



# AEP Transmission Zone Reinforcement

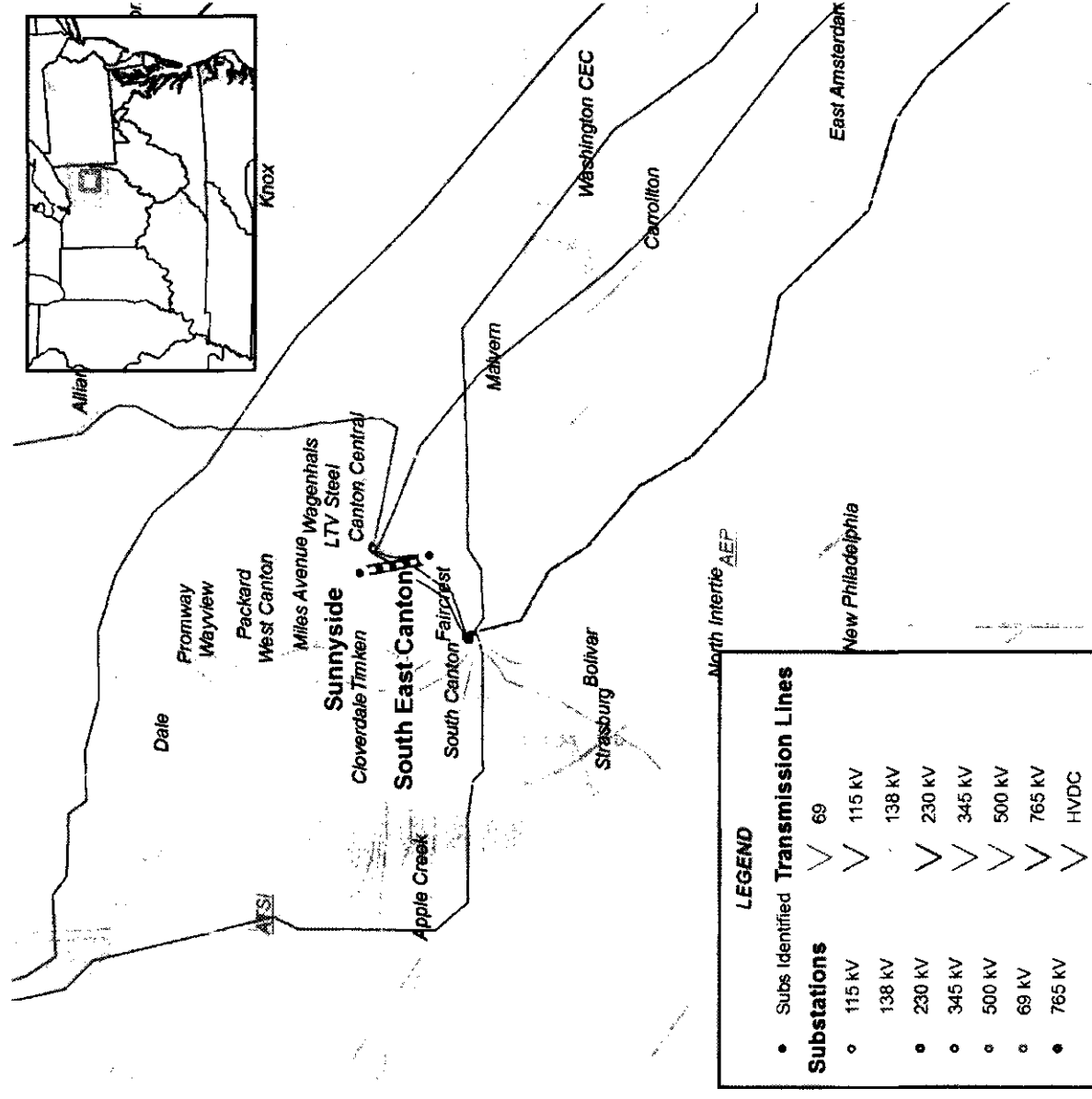
- The Canton Central - Southeast Canton 138kV line loads to 173.5% of its rating of 296 for the single contingency loss of Canton Central 345/138 kV transformer #12 followed by the loss of S.Canton - Torrey 138 kV line and SE Canton - Sunnyside 138 kV line
- Sag Study on 7.2 miles SE Canton-Canton Central 138kV ckt.
- Estimated Project Cost: \$0.3M
- Projected in-service date: 12/1/2012





# AEP Transmission Zone Reinforcement

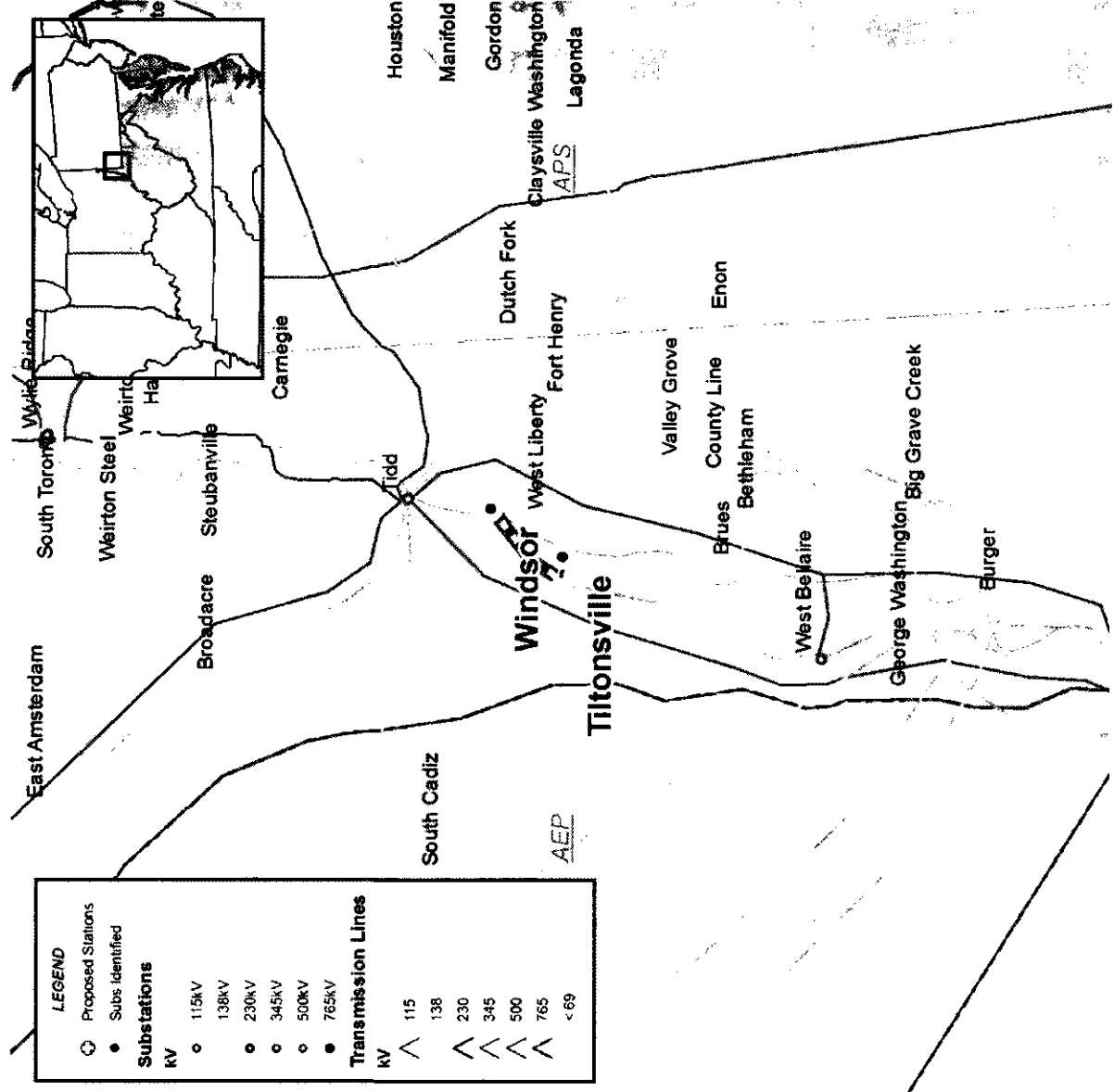
- The Southeast Canton
  - Sunnyside 138kV line loads to 113.4% of its rating of 296 for the single contingency loss of Canton Central
  - SE Canton 138 kV line followed by the loss of S.Canton - Torrey 138 kV line.
- Sag study on the Southeast Canton - Sunnyside 138kV line
- Estimated Project Cost: \$0.25M
- Projected in-service date: 12/1/2012





# AEP Transmission Zone Reinforcement

- The Tiltonsville - Windsor ckt 1 138/138kV line loads to 137.3% of its rating of 205 MVA for the stuck breaker contingency loss of Kammer - S.Canton 765 kV line, Kammer 765/500 kV transformer, S.Canton 765/345 kV transformer, Kammer - 502 Junction 500 kV line, and S.Canton 345/138 kV transformer #4.
- Sag study on the Tiltonsville - Windsor 138 kV circuit (existing base line upgrade b1457)
- Estimated Project Cost: \$.02M
- Projected in-service date: 12/1/2012



**LEGEND**

**Substations**

- Subs Identified
- 115 kV
- 138 kV
- 230 kV
- 345 kV
- 500 kV
- 69 kV
- 765 kV

**Transmission Lines**

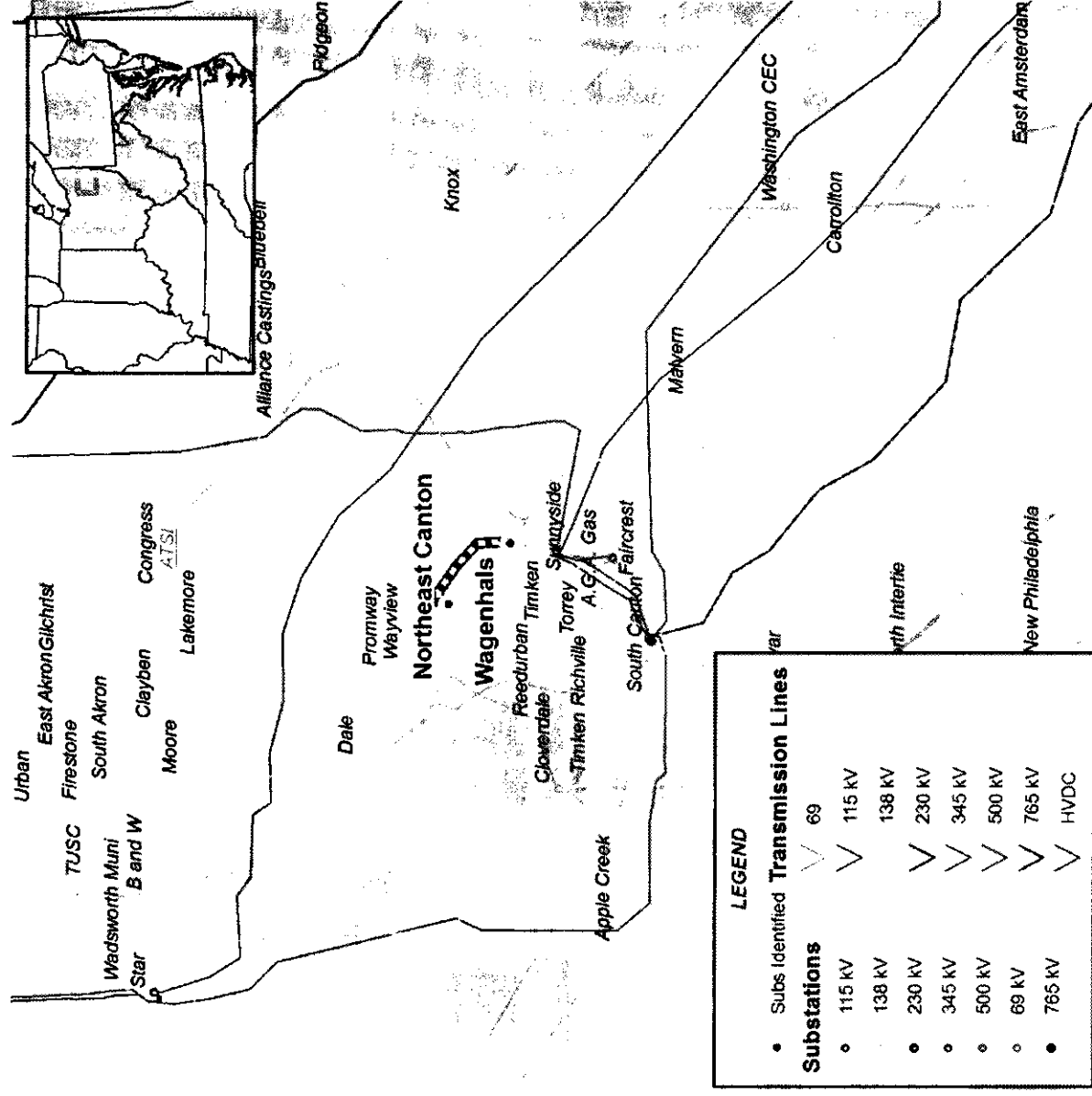
- > 69
- > 115 kV
- > 138 kV
- > 230 kV
- > 345 kV
- > 500 kV
- > 69 kV
- > 765 kV
- > HVDC

- PJM TEAC  
04/27/2012



# AEP Transmission Zone Reinforcement

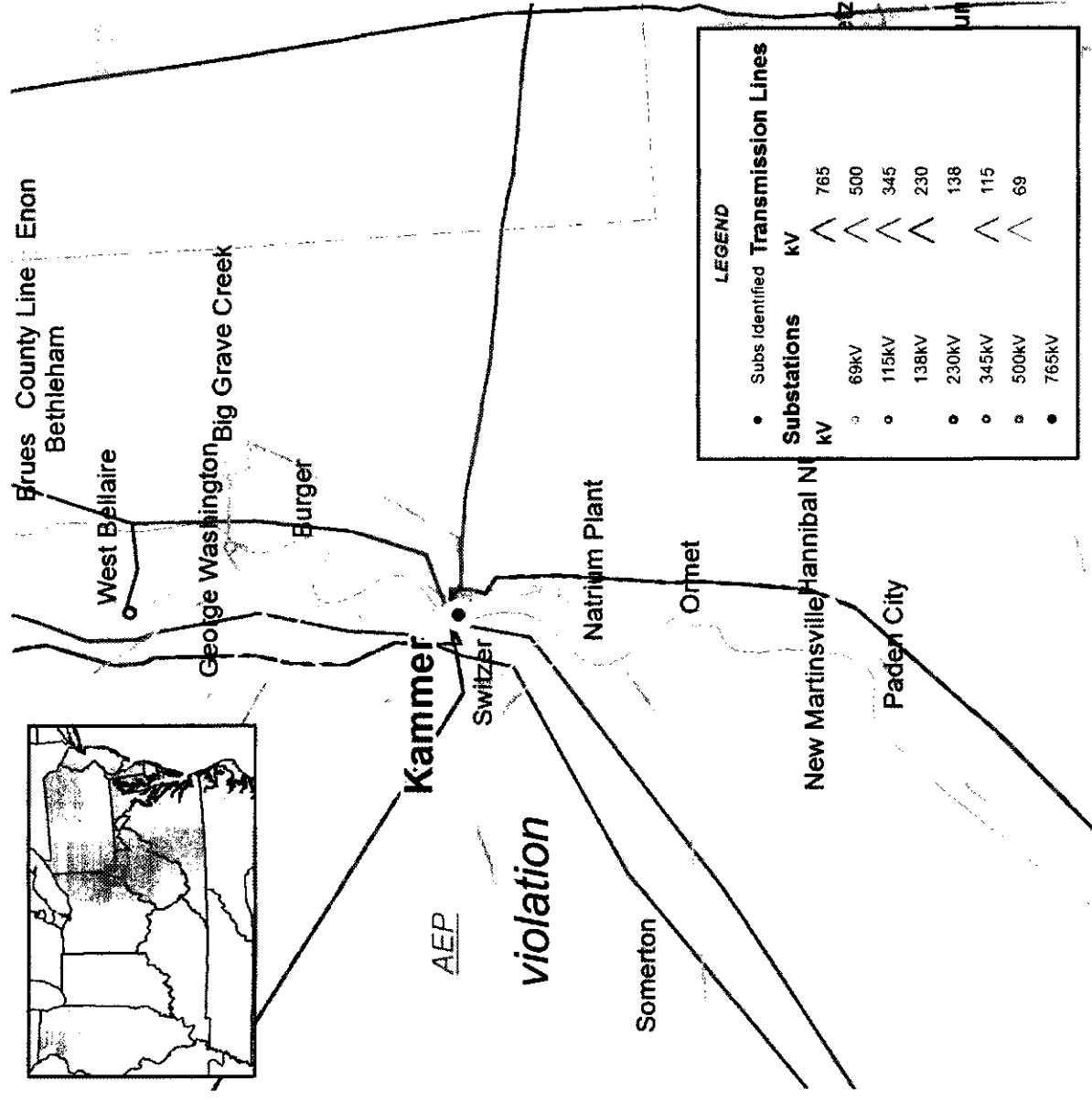
- The Northeast Canton - Wagenhals 138kV line loads to 110.9% of its rating of 205 for the single contingency loss of the S.Canton 345/138 kV transformer #1 followed by loss of the Negley - Reedurban 138 kV line and Negley - Torrey 138 kV line.
- Sag study on the North East Canton - Wagenhals 138kV circuit (existing base line upgrade b1500)
- Estimated Project Cost: \$0.02M
- Projected in-service date: 12/1/2012





# AEP Transmission Zone Reinforcement

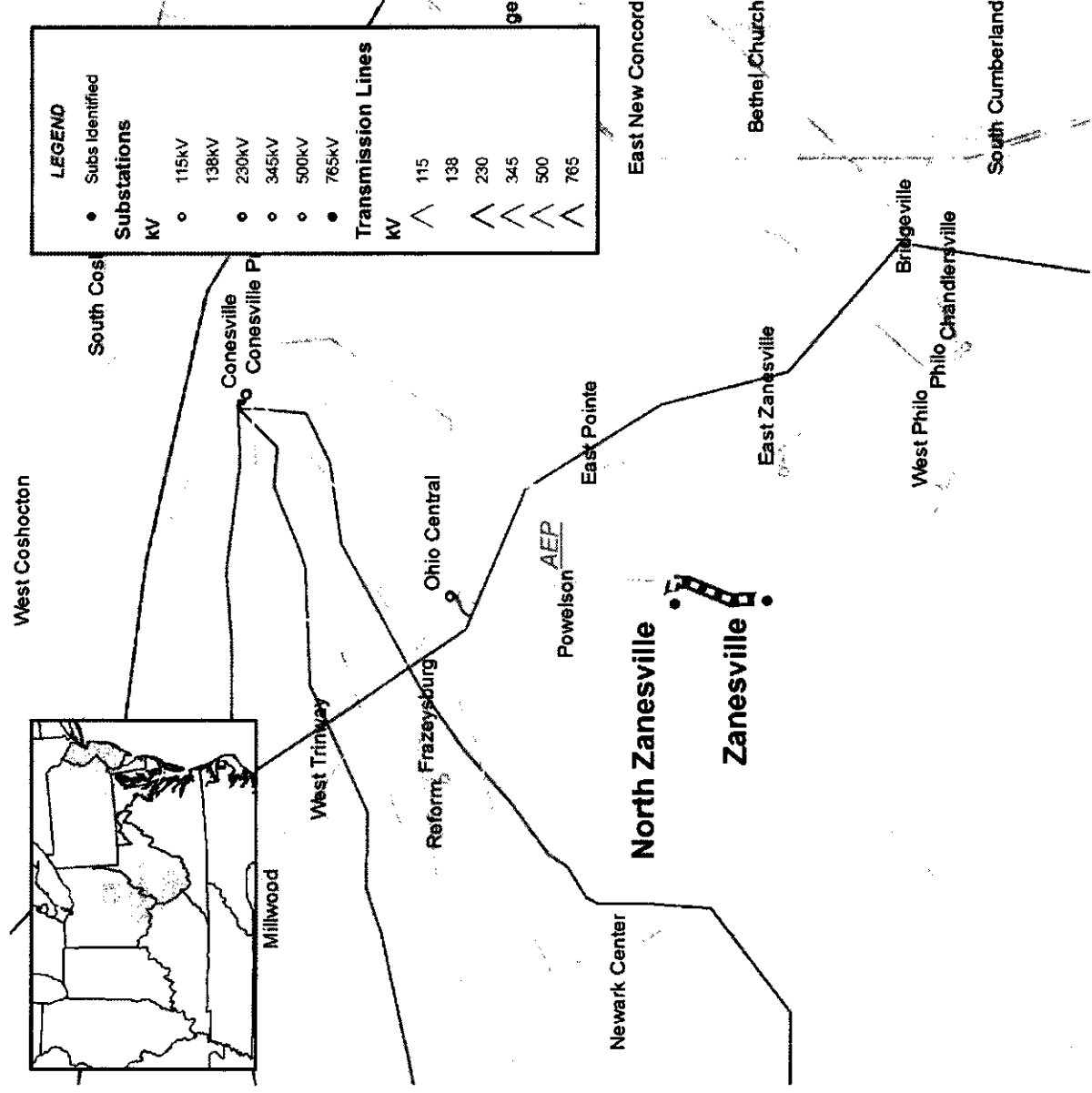
- The Belmont #1 765/500kV transformer overloads to 117.11% for the stuck breaker contingency loss of Kammer – S.Canton 765 kV line, Kammer 765/500 kV transformer, S.Canton 765/345 kV transformer, Kammer – 502 Junction 500 kV line, and S.Canton 345/138 kV transformer #4.
- Add four 765 kV breakers at Kammer remove stuck breaker contingency which causes several violations.
- Estimated Project Cost: \$30M
- Projected in-service date: 6/1/2015





# AEP Transmission Zone Reinforcement

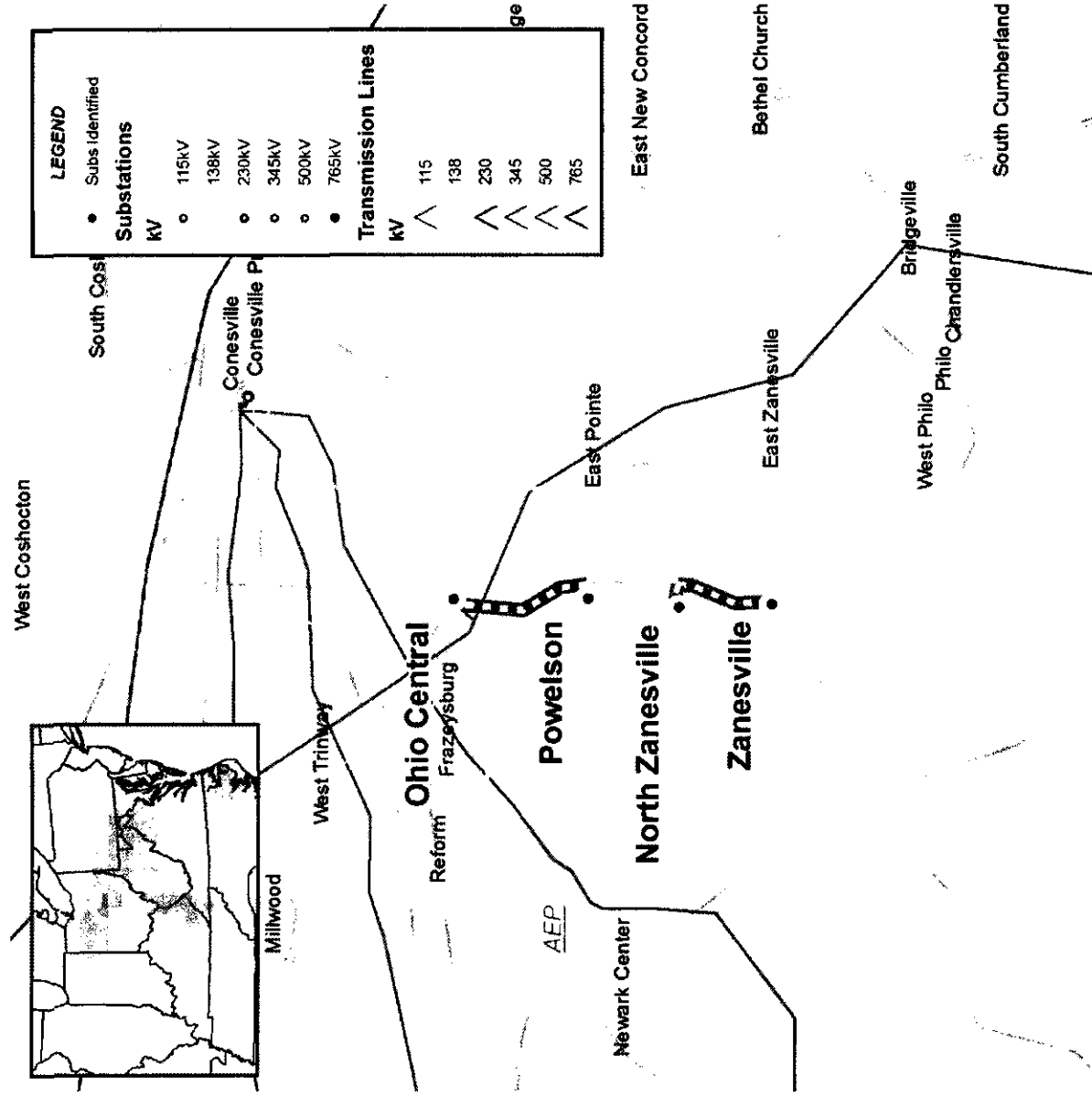
- The North Zanesville - Zanesville ckt 1 138kV line loads to 108.11% of its rating of 205 MVA for the bus contingency at Ohio Central
- Sag study on the North Zanesville - Zanesville 138 kV circuit (existing base line upgrade b1452)
- Estimated Project Cost: \$.01M
- Projected in-service date: 12/1/2012





# AEP Transmission Zone Reinforcement

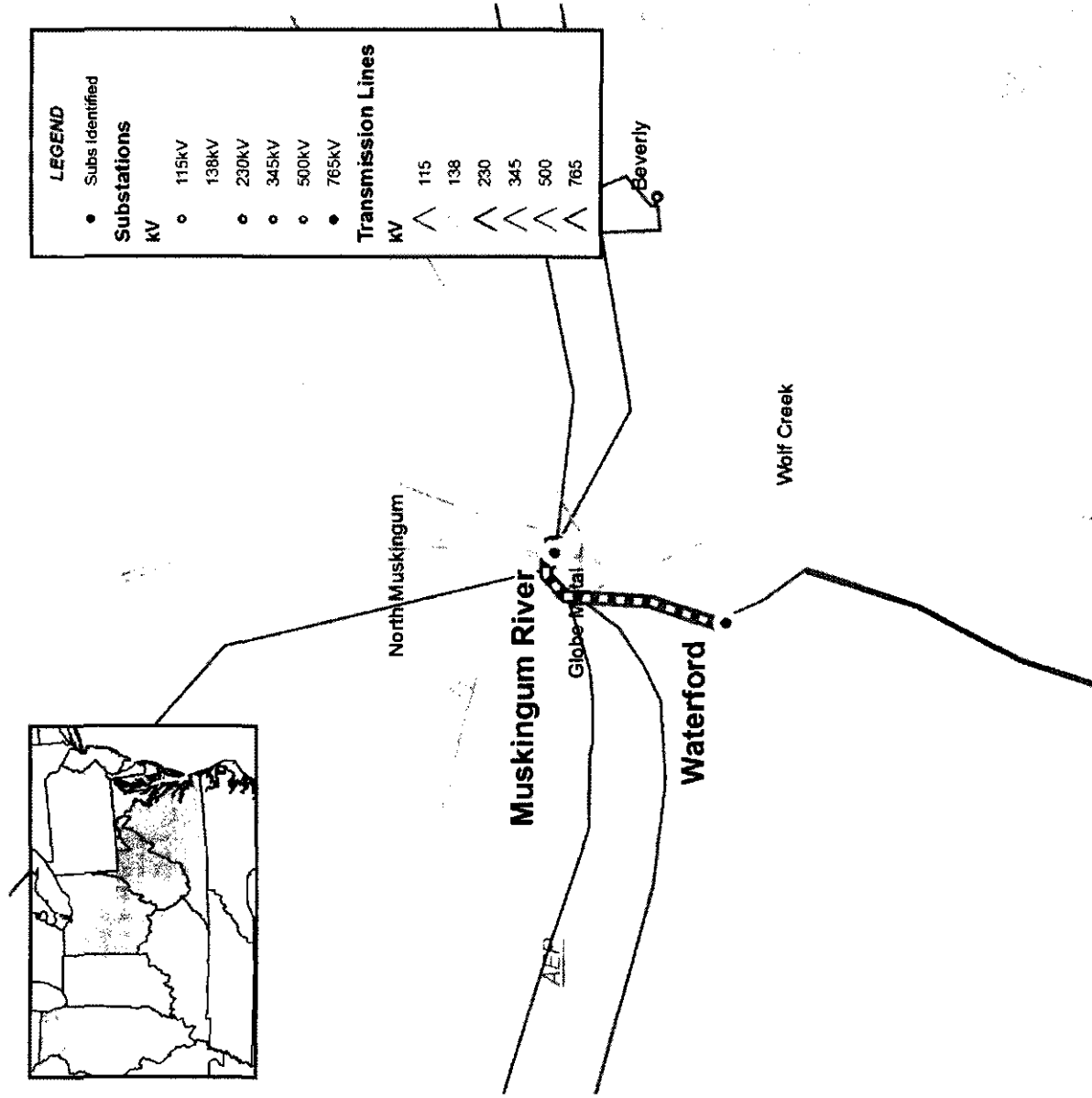
- The Ohio Central - Powelson 138 kV line loads to 118.61% of its rating of 205 MVA for the bus contingency loss of the Ohio Central - E. Point 138 kV line and Ohio Central - S. Coshocton 138 kV line & The Powelson - North Zanesville ckt 1 138kV line loads to 116.64% of its rating of 205 MVA for the bus contingency loss of the Ohio Central - E. Point 138 kV line and Ohio Central - S. Coshocton 138 kV line
- Sag study on the North Zanesville - Powelson and Ohio Central - Powelson 138 kV circuit (existing base line upgrade b1453)
- Estimated Project Cost: \$.1304M
- Projected in-service date: 12/1/2012





# AEP Transmission Zone Reinforcement

- The Waterford - Muskingum River 345 kV line loads to 123.76% of its rating for the single contingency loss of the Belmont 765 kV bus.
- Sag study on the Waterford - Muskingum 345kV circuit (existing base line upgrades b1811.1, 1811.2)
- Build approximately 1 mile of circuit comprising of 2-954 ACSR to get the rating higher.
- Estimated Project Cost: \$3.5M
- Projected in-service date: 12/1/2013

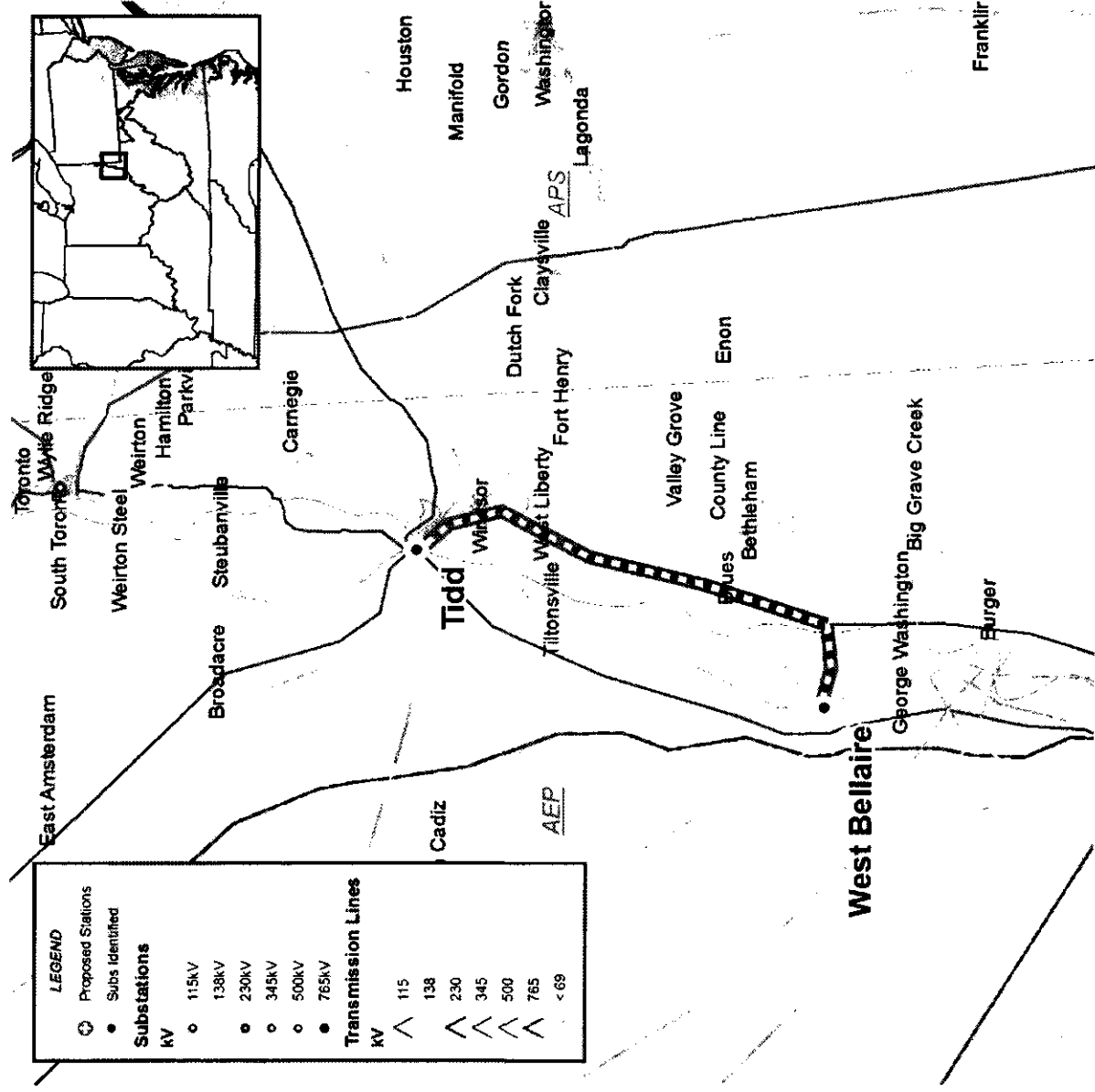




# AEP Transmission Zone Reinforcement

- The West Bellaire - Tidd 345 kV line loads to 111.47% of its rating of 971 MVA for the stuck breaker – contingency loss of Kammer – S.Canton 765 kV line, Kammer 765/500 kV transformer, S.Canton 765/345 kV transformer, Kammer – 502 Junction 500 kV line, and S.Canton 345/138 kV transformer #4.

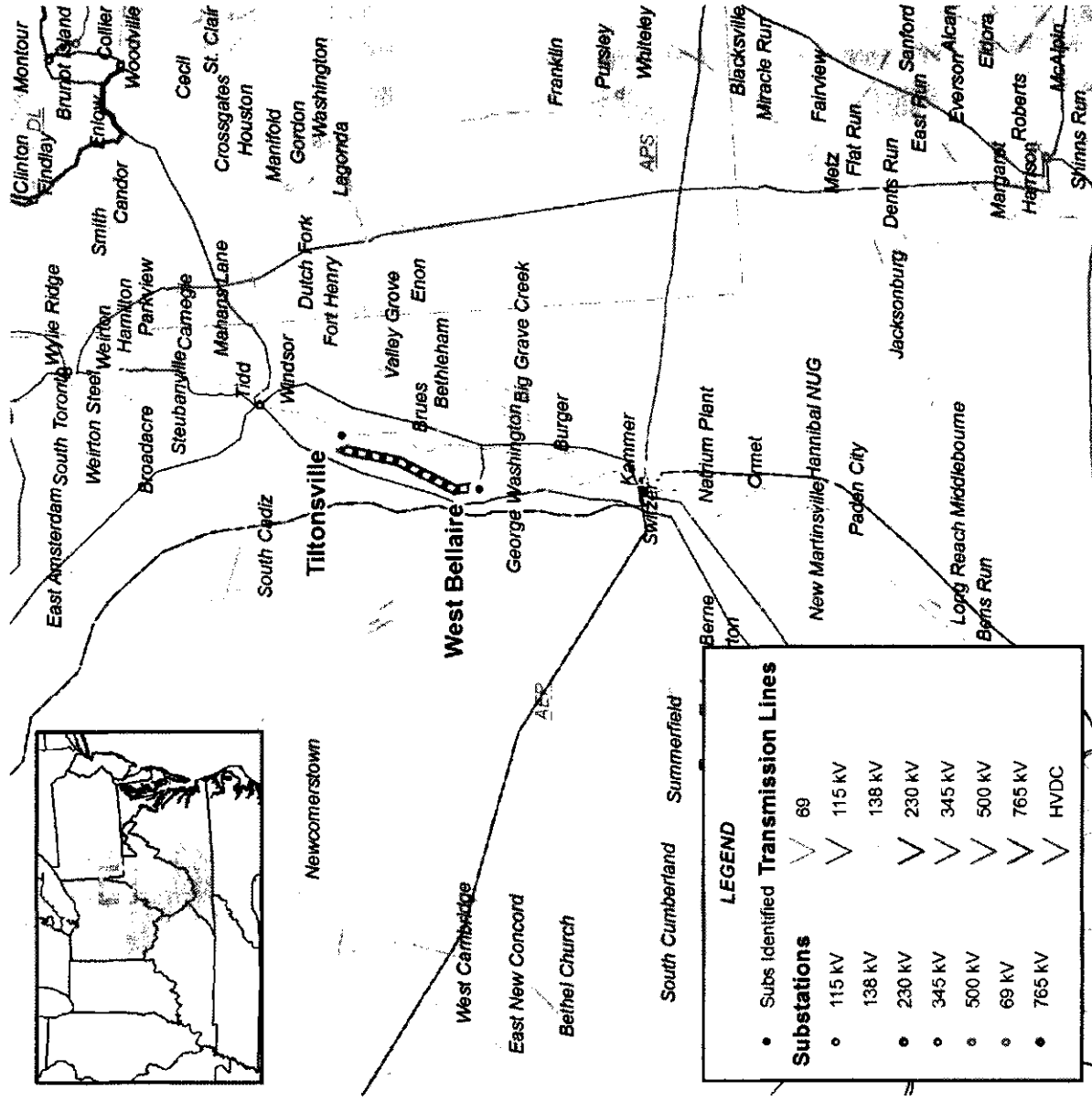
- Sag study on the Tidd-West Bellaire 345kV circuit (existing base line upgrade b1456)
- Estimated Project Cost: \$0.07M
- Projected in-service date: 12/1/2012





# AEP Transmission Zone Reinforcement

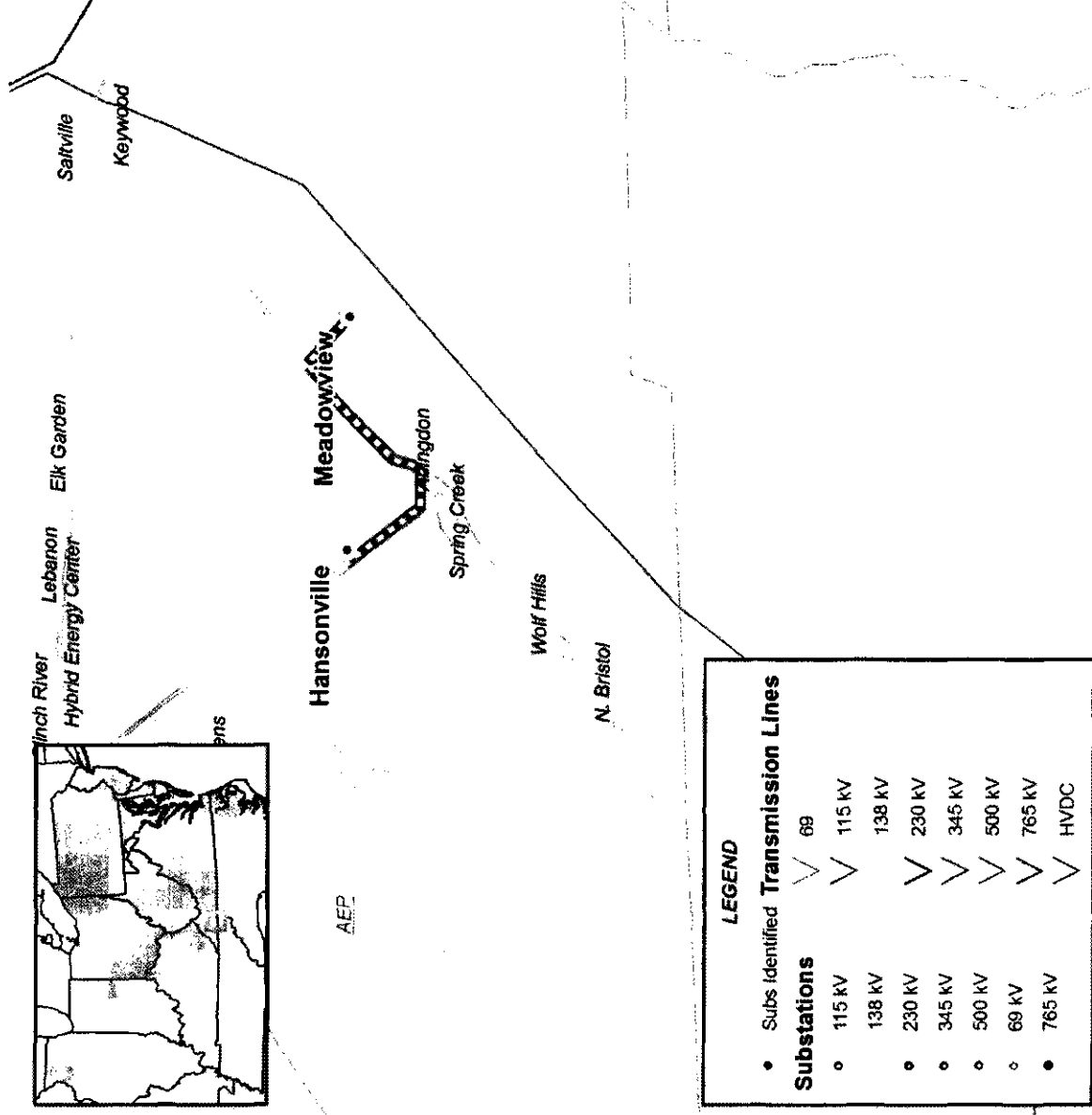
- The West Bellaire - Tiltonsville 138 kV line loads to 110.8% of its rating of 251 MVA for the stuck breaker contingency loss of the Tidd - Wylie Ridge 345 kV line and Tidd- Collier 345 kV line.
- Perform a Sag Study on section 1 (~12 miles) of the West Bellaire - Tiltonsville 138 kV line (existing base line upgrade b1457)
- Estimated Project Cost: \$0.02M
- Projected in-service date: 12/1/2012





# AEP Transmission Zone

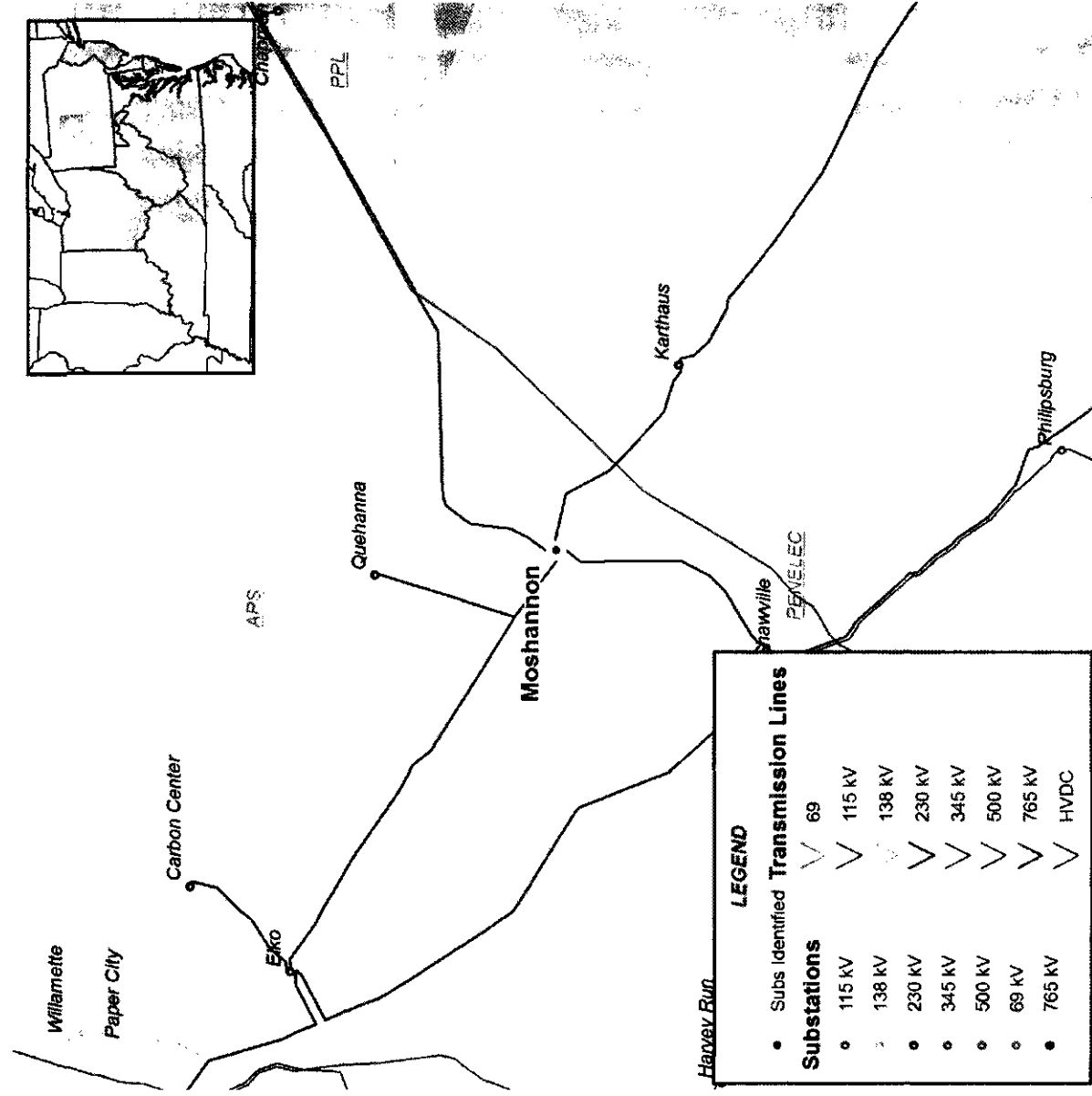
- The Hanson - Meadowview 138 kV line loads to 102.91% of its rating for the single contingency loss of the Lebanon 138 kV bus.
- Perform a Sag Study on the Hansonville – Meadowview 138kV line (Improve the emergency rating to 245 MVA). (B1879 )
- Estimated Project Cost: \$0.1M
- Expected IS date: 06/01/2016





# AP Transmission Zone Reinforcement

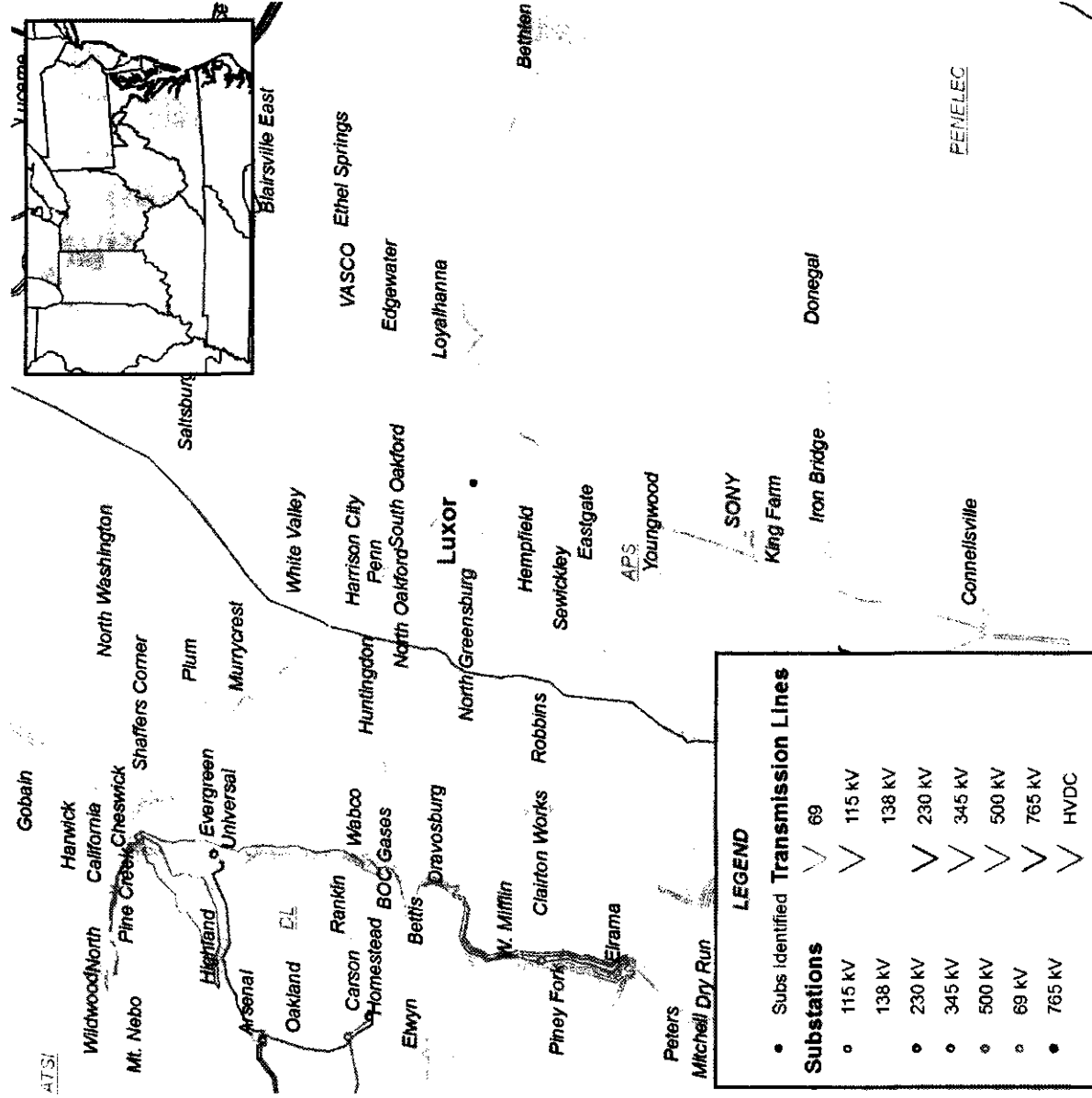
- The Shawville-Shingletown 230 kV line loads to 127.71% of its emergency rating of 505MVA for the bus contingency loss of the Moshannon 230 kV bus.
- Convert Moshannon substation to a 4 breaker 230 kV ring bus
- Estimated Project Cost: \$6.5M
- Projected in-service date: 6/1/2014





# AP Transmission Zone Reinforcement

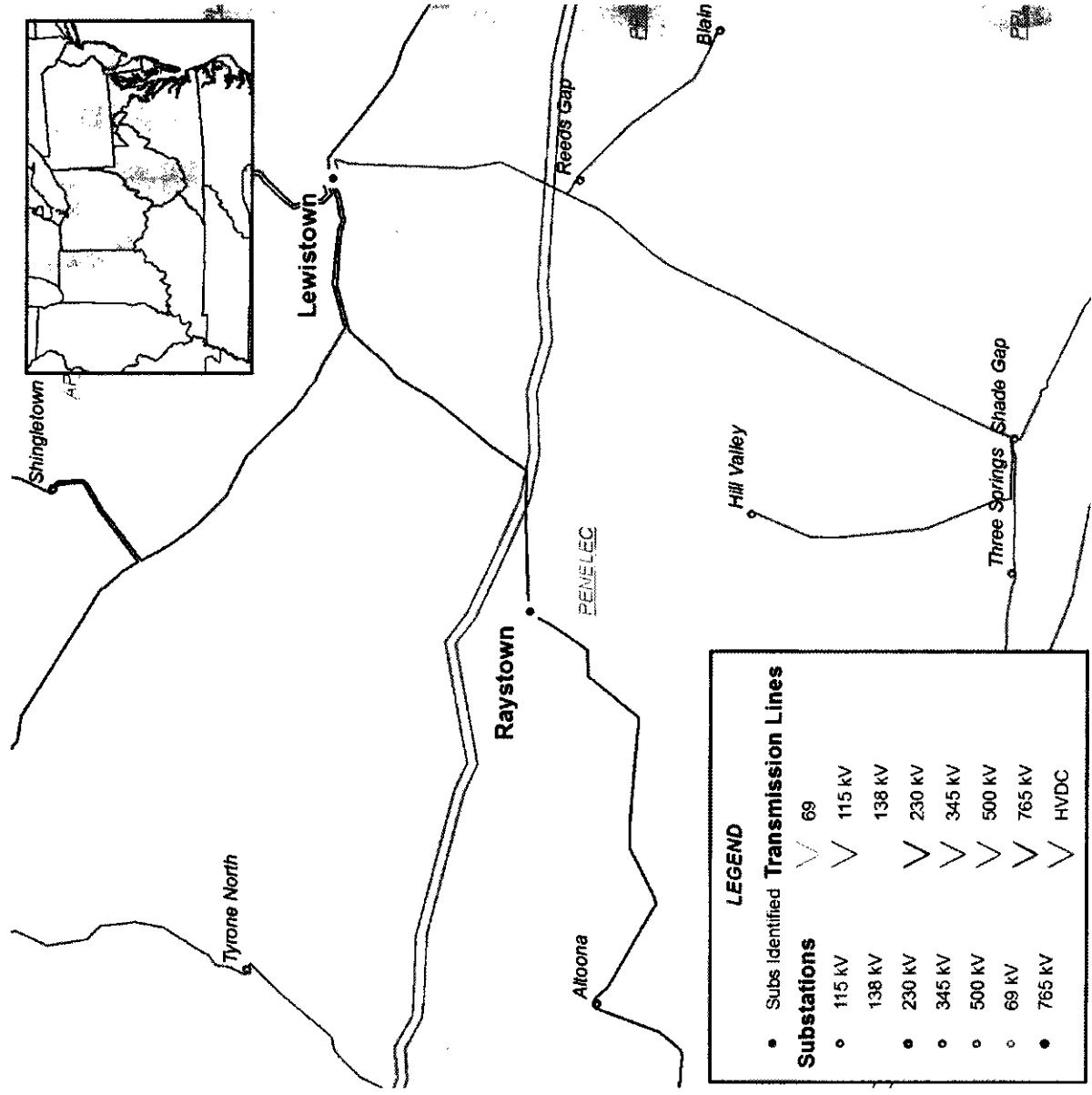
- Low voltage of 0.86pu is observed on the Luxor 138kV bus for the single contingency loss of the Waltz Mills tap 138 kV bus followed by loss of the Yukon – Youngwood 138 kV line.
- Install a 44 MVAR 138 kV capacitor at Luxor substation
- Estimated Project Cost: \$1.5M
- Projected in-service date: 6/1/2014





# PN Transmission Zone Reinforcement

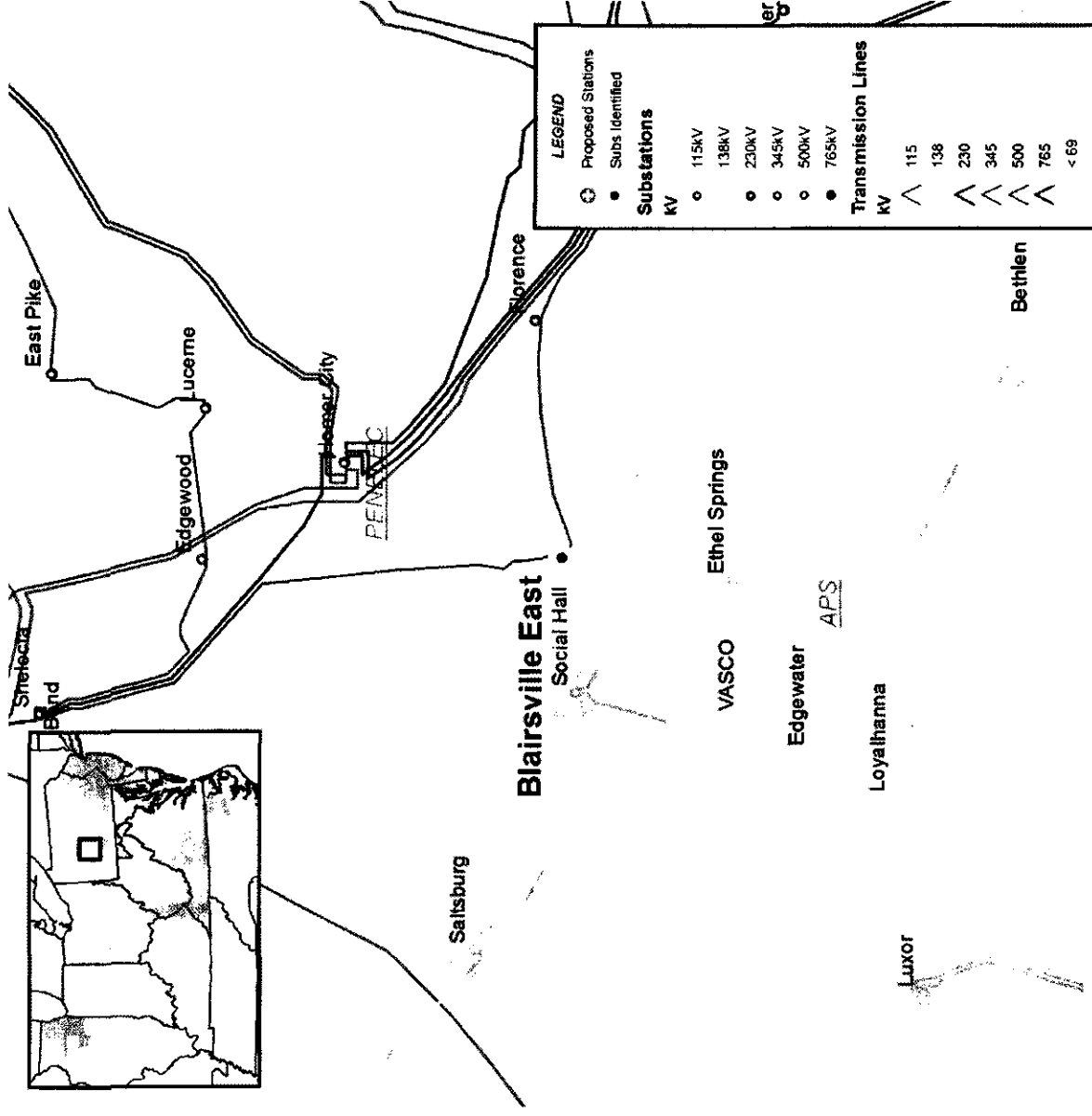
- The Raystown – Lewistown 230 kV line loads to 115.23% of its emergency rating of 570 MVA for the single contingency loss of the Juniata – Keystone 500 kV line.
- Replace the 1200 Amp Line trap at Lewistown on the Raystown-Lewistown 230 kV line and replace substation conductor at Lewistown
- Estimated Project Cost: \$0.15M
- Projected in-service date: 12/1/2013





# PN Transmission Zone Reinforcement

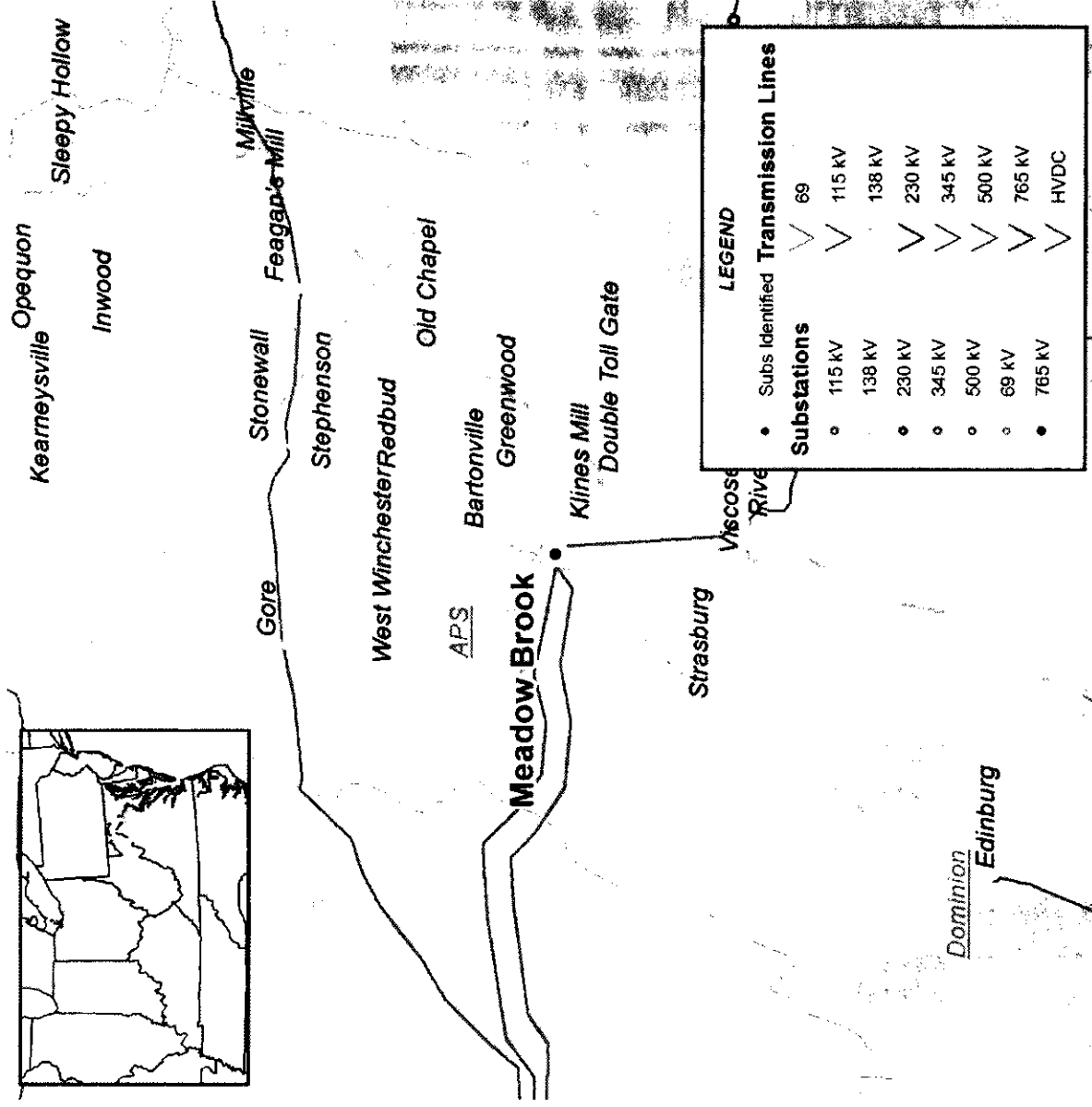
- The Barnetts Run – Luxor 138kV line loads to 111.2% of its emergency rating of 179 MVA for the single contingency loss of the Yukon – Youngwood 138 kV line + loss of Yukon – Waltz Mills Tap 138 kV line
- Replace the Blairsville 138/115 kV transformer
- Estimated Project Cost: \$4.2M
- Projected in-service date: 6/1/2014





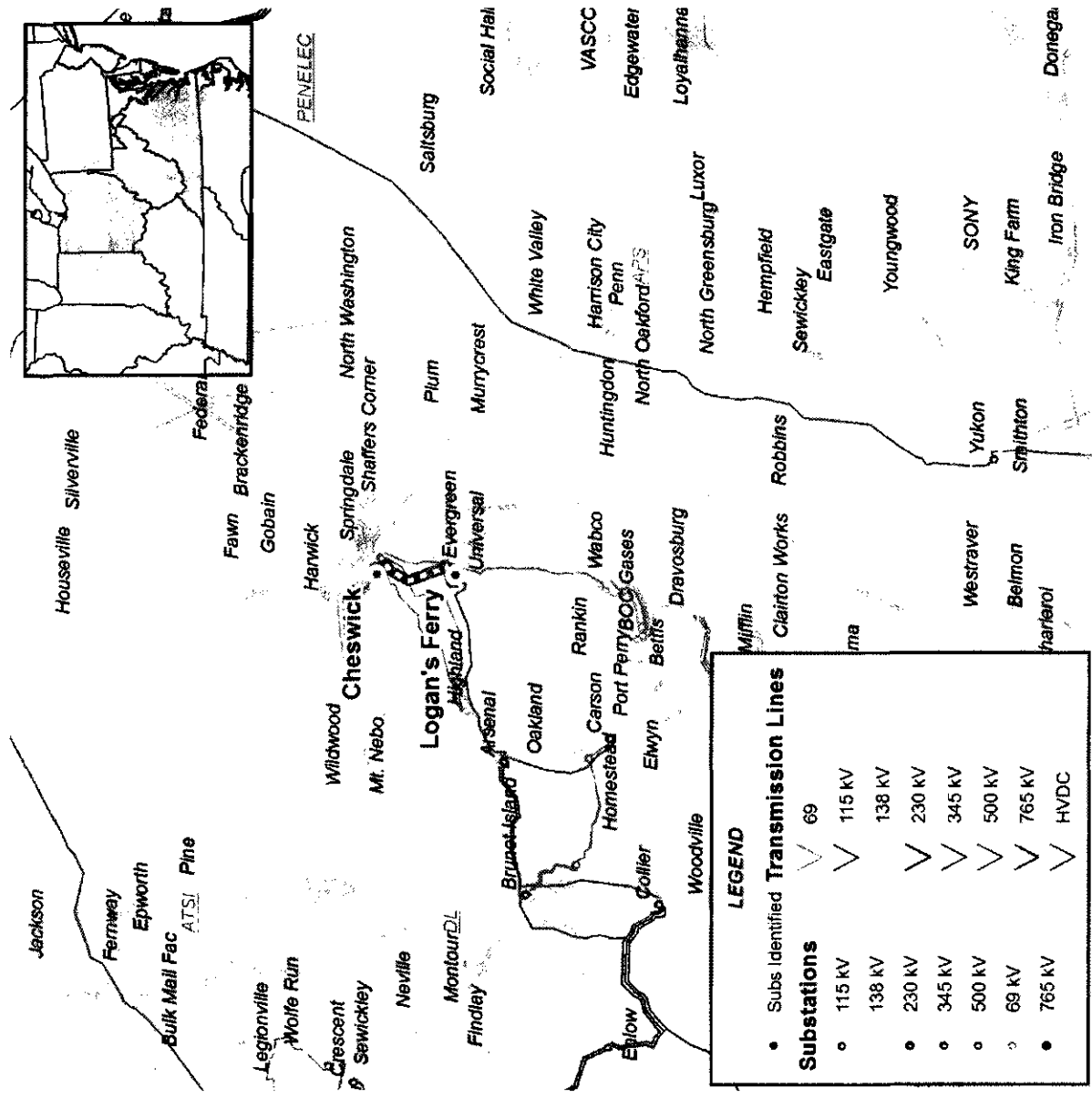
# AP Transmission Zone Reinforcement

- The Niles and Elrama deactivations also aggravated voltages problems on the 500 kV system
- Install 600MVAR SVC at Meadow Brook substation (existing base line upgrade b1804)
- Estimated Project Cost: \$60M
- Projected in-service date: 6/1/2014





# DLCO Reinforcement

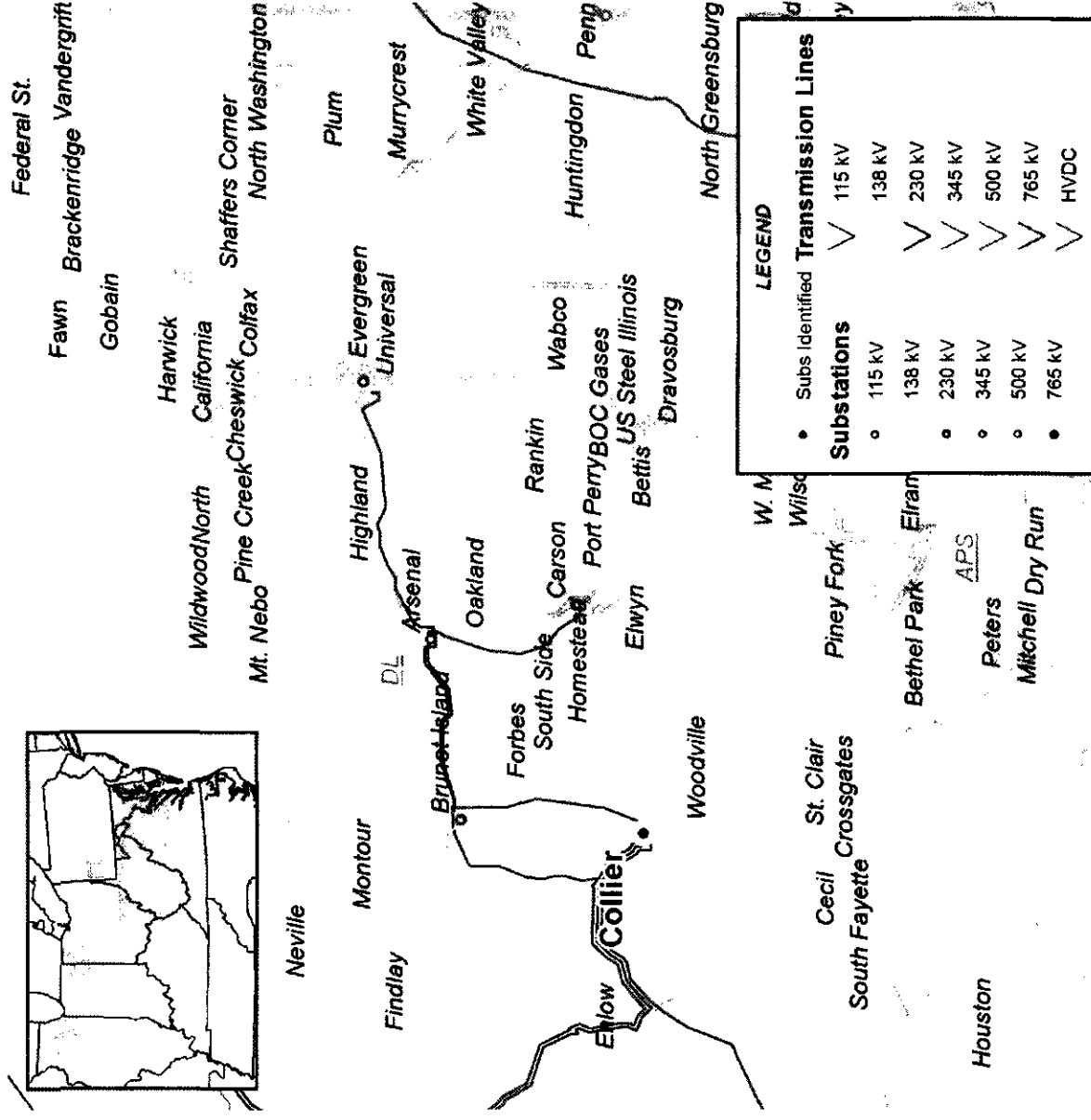


- The Cheswick – Wilmerding 138kV line loads to 108.11% of its emergency rating of 248MVA for the stuck breaker contingency loss of the Cheswick 138 kV lines Z-50,Z-52,Z-53, and Z-54.
- Establish operating procedure such that breaker 89, connecting Cheswick-Logans Ferry Z-53 to the No. 3 138 kV bus at Cheswick Substation is normally open.
- Estimated Project Cost: \$0
- Projected in-service date: 6/1/2012



# DLCO Reinforcement

- The Collier 345/138kV transformer loads to 108.94% of its emergency rating of 382 MVA for the stuck breaker contingency loss of the Collier – Brunot Island 345 kV line and loss of Collier 345/138 kV transformer #2
- Install a third 345-138 kV autotransformer at Collier Substation. Currently s0321 and will be converted to baseline. 138kV breaker replacements identified as overduetied with the installation of the 3rd transformer
- Estimated Project Cost: \$8M
- Projected in-service date: 6/1/2013

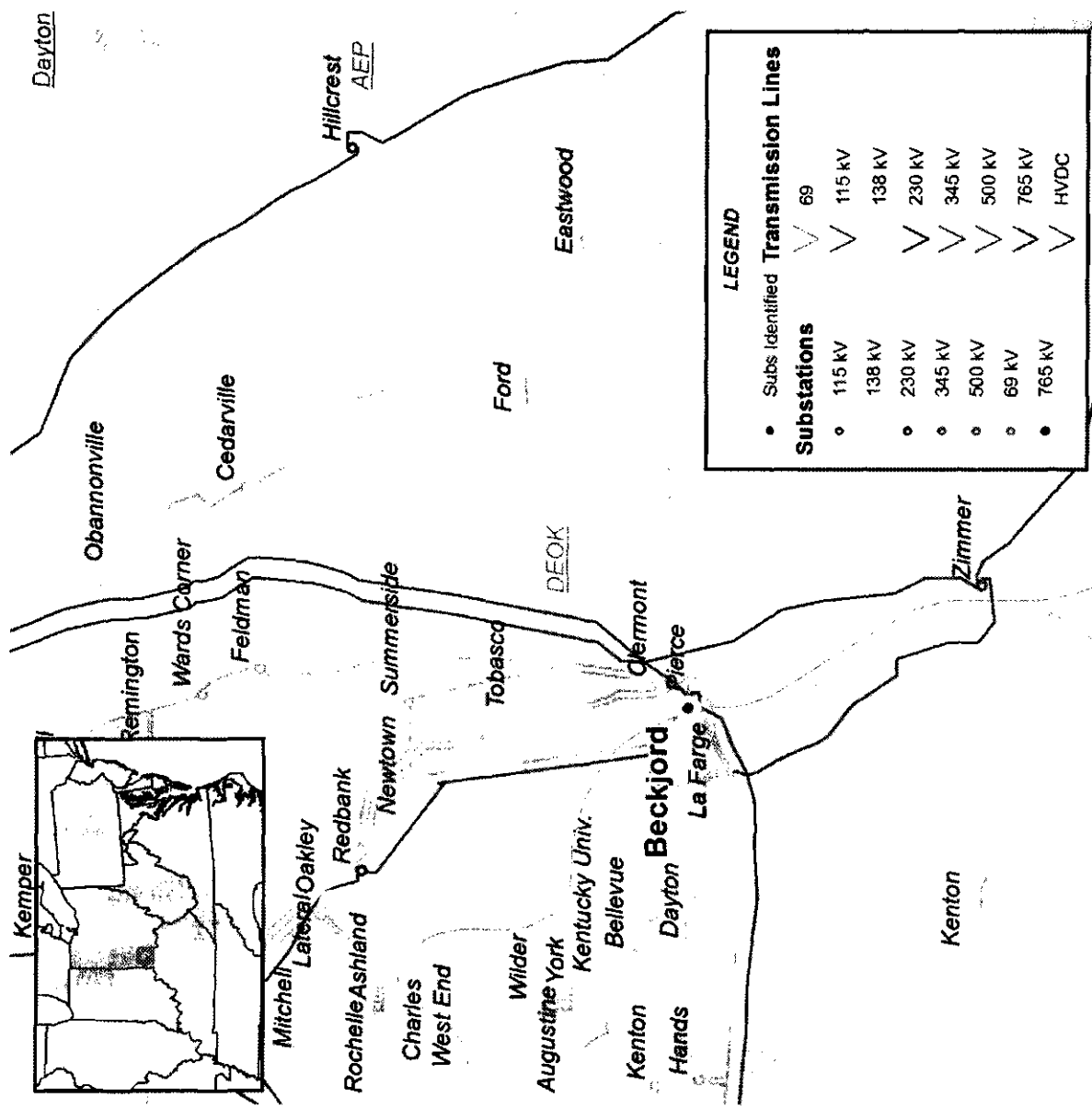




# DEOK (Duke Energy) Deactivations

## Beckjord 1

- Requested deactivation date: 5/1/2012
- No violations identified

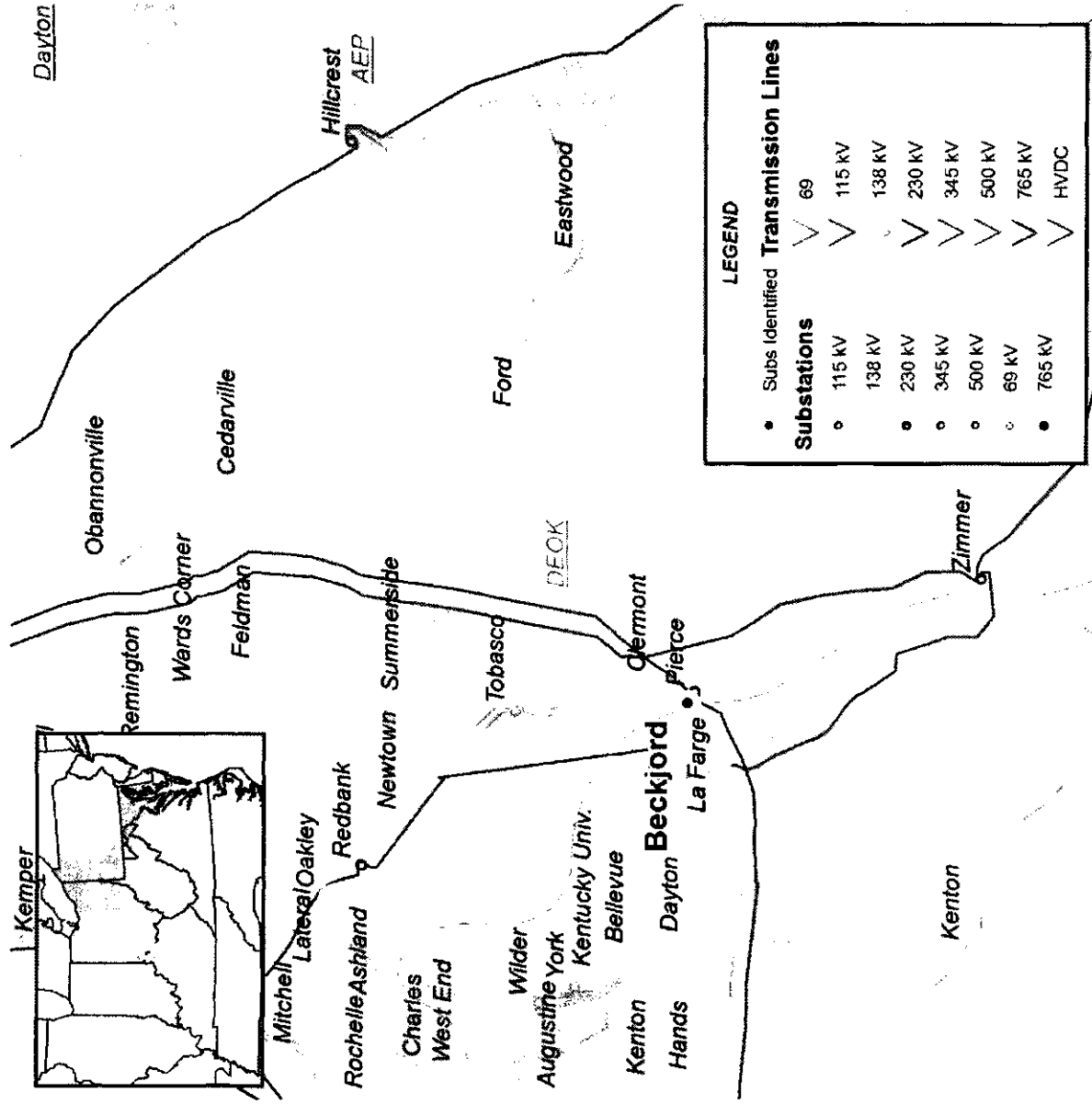




# DEOK (Duke Energy) Deactivations

Beckjard 2, 3, 4, 5, & 6

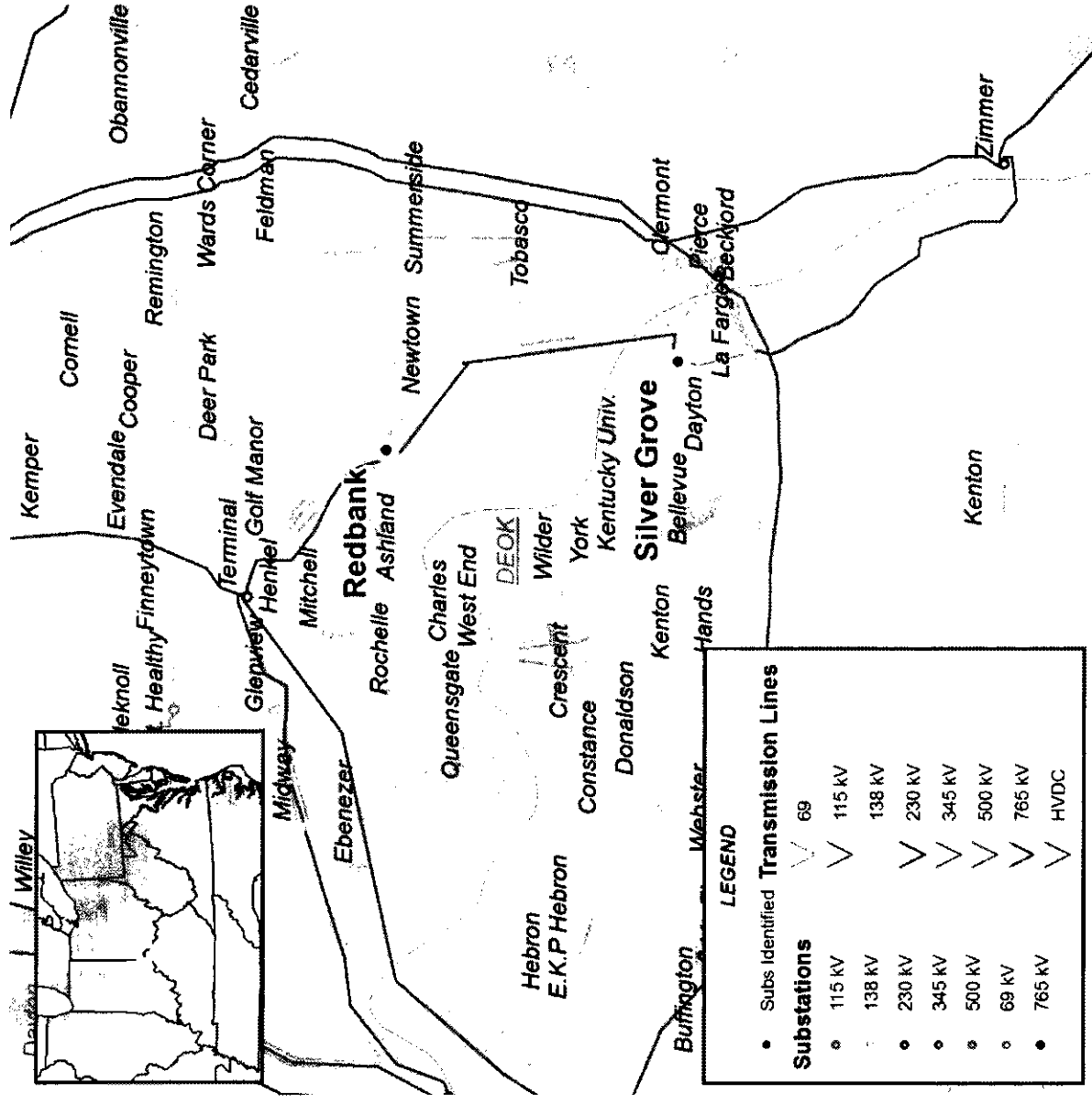
Requested deactivation  
date: 4/1/2015





# DEOK Transmission Zone Violations / Reinforcement

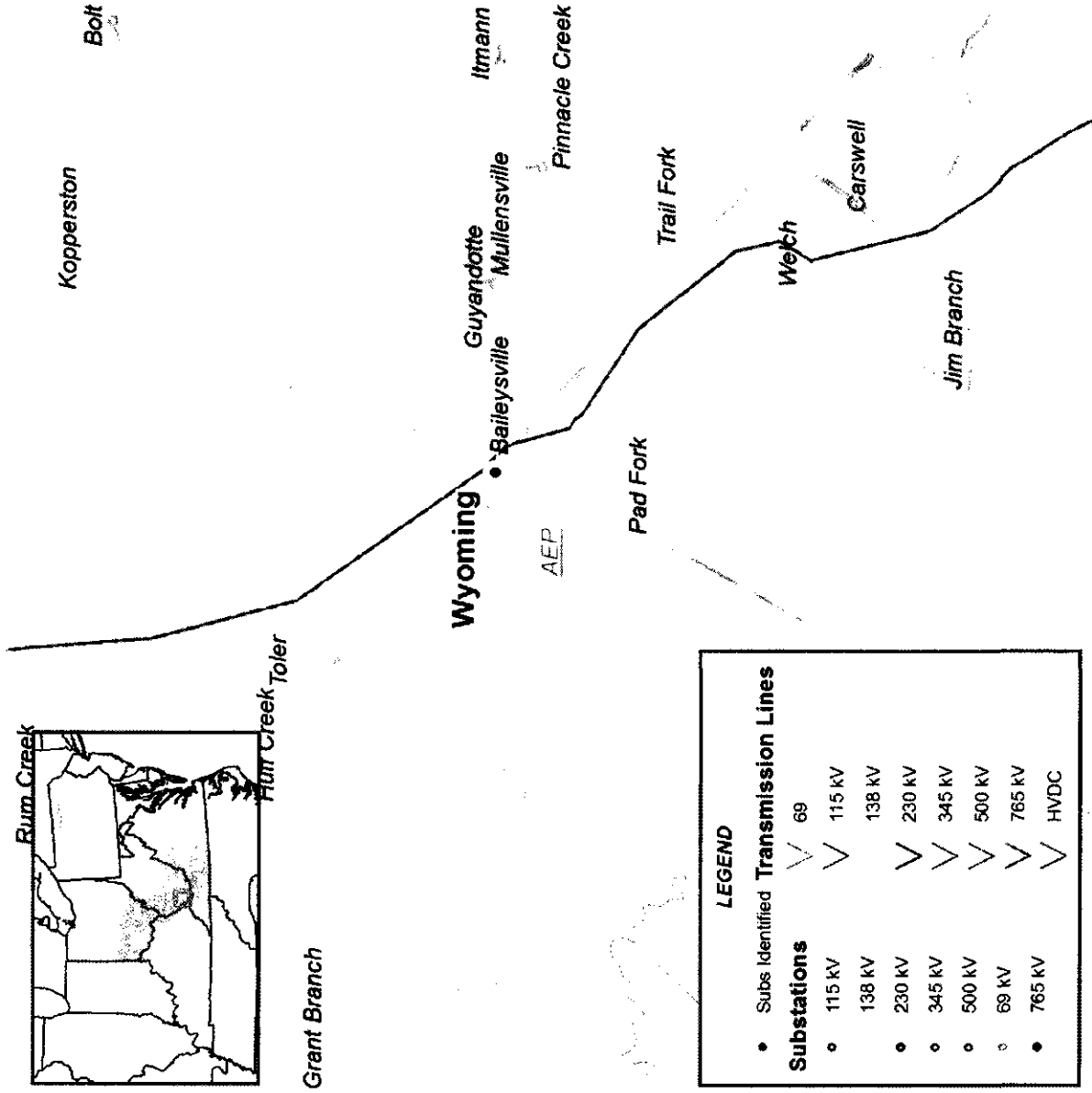
- Criteria violation
  - Generation Deliverability
- Overload of Silver Grove 345/138kV transformer and equipment
- Convert Redbank 345 kV bus to ring (b1822)
- cost
- Projected in-service date: 6/1/2013





# AEP Transmission Zone Violations / Reinforcement

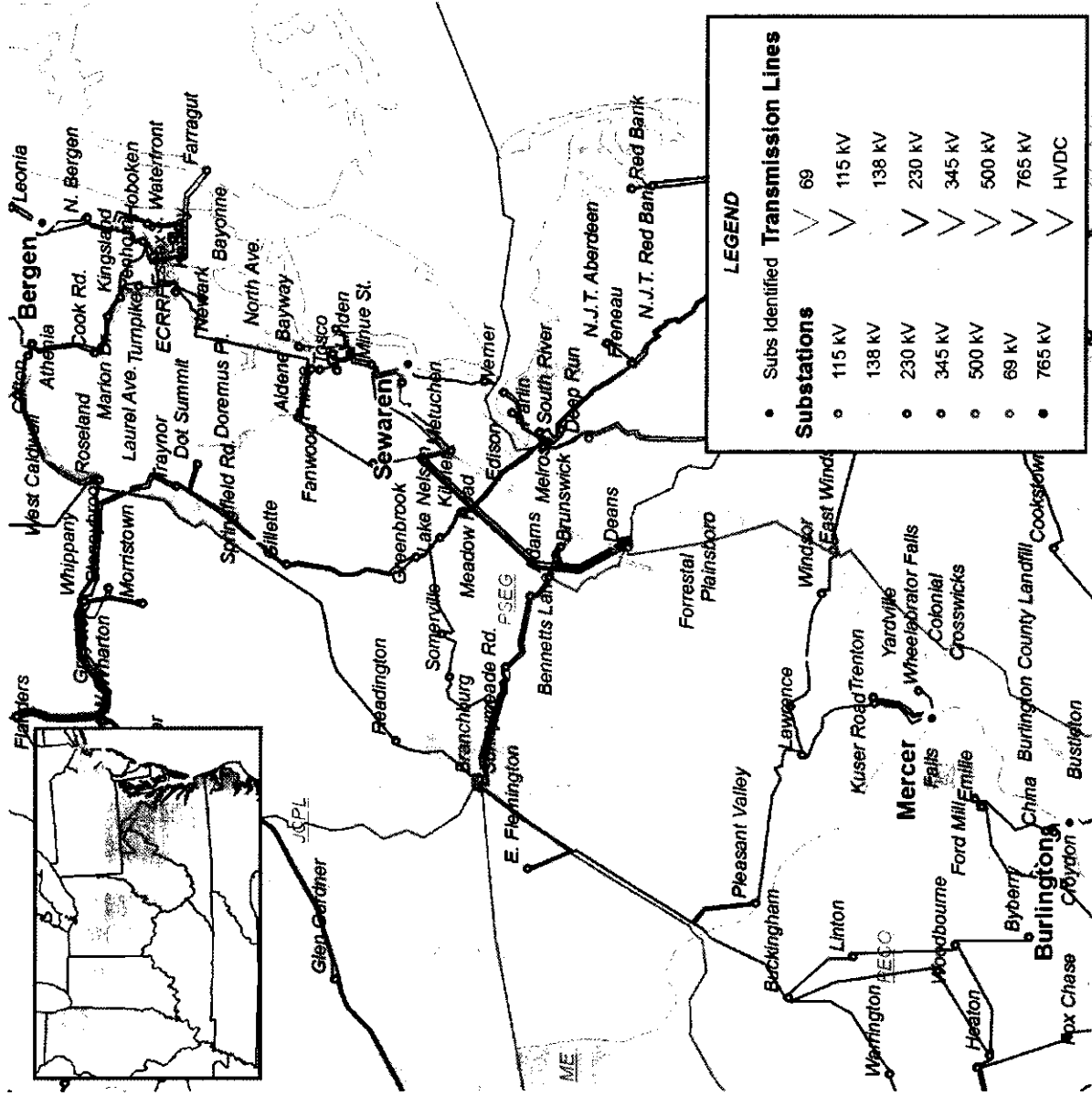
- Criteria violations
  - N-1 Common Mode Voltage
- Multiple 138kV voltage violations due to 765kV breaker contingency at Wyoming 765kV
- Install a 765kV breaker at Wyoming 765kV substation (existing baseline upgrade b1661)
- Estimated Project Cost: \$5M
- Projected to be in-service by 6-1-2014





# PSEG (PSEG Energy) Deactivations

- Bergen 3; Burlington 8; National Park 1; Mercer 3; Seawaren 6
- Requested deactivation date: 6/1/2015

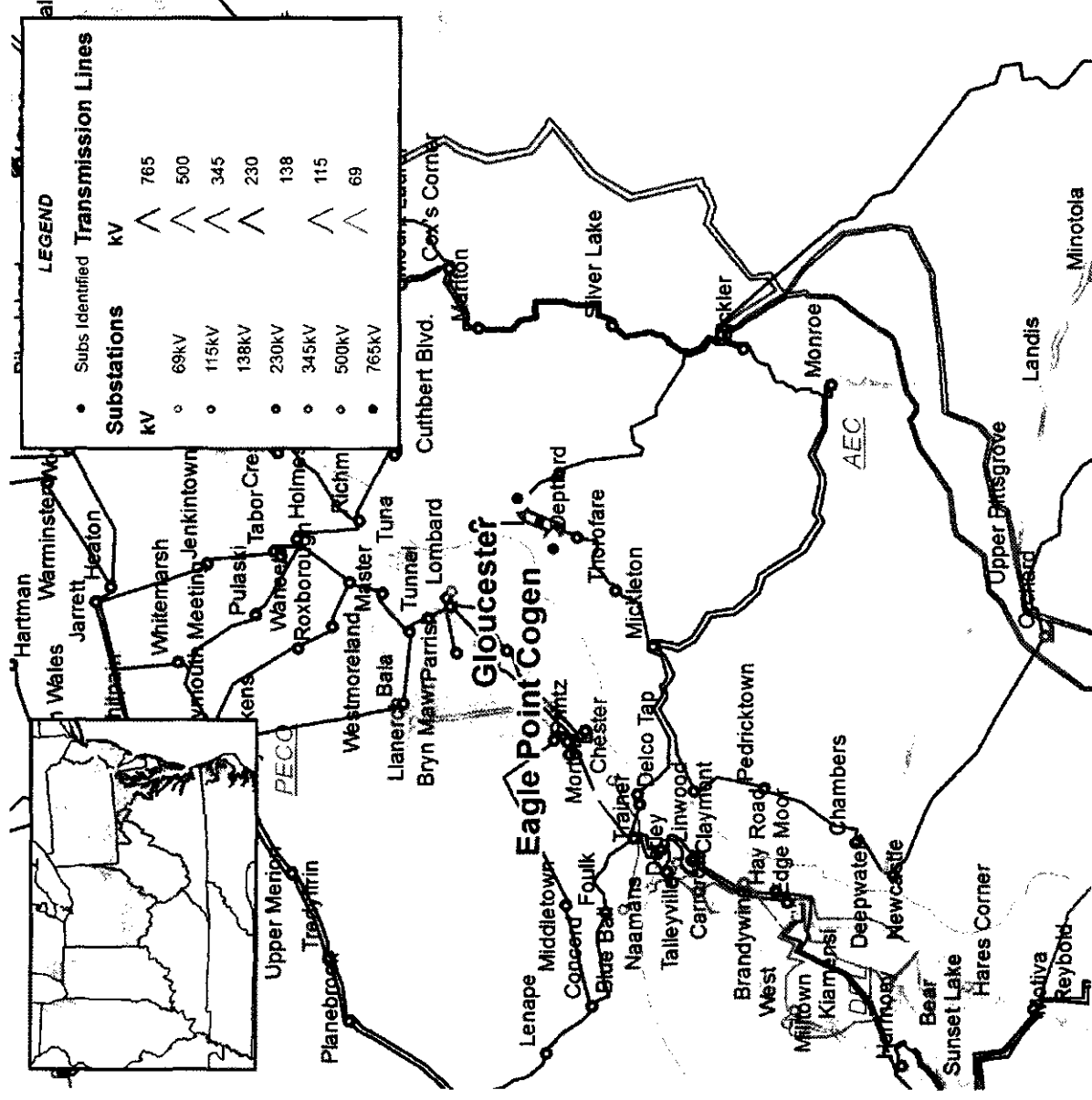




# PSEG Transmission Zone

\*Solution under review\*

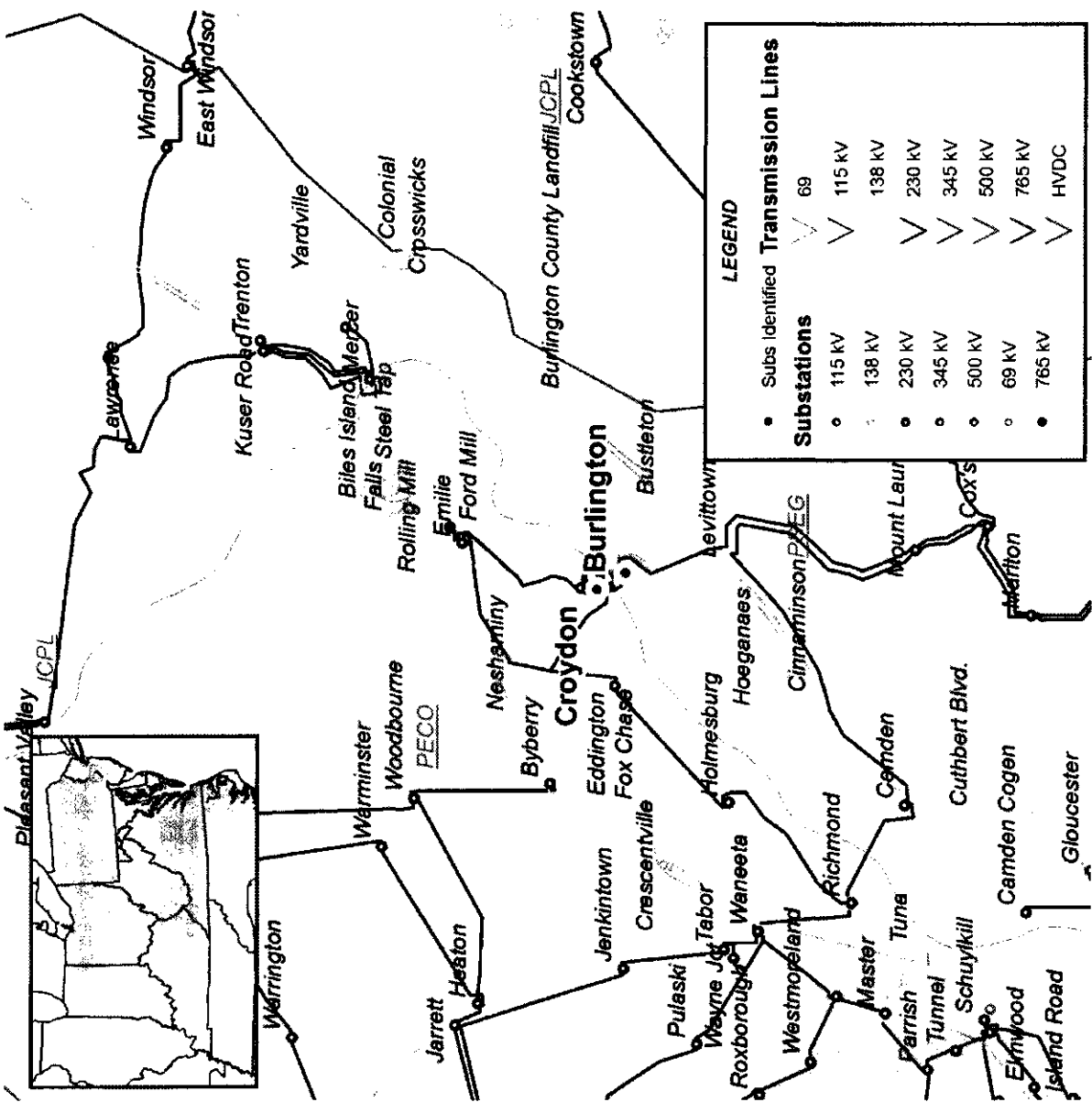
- Generation Deliverability
- Eagle Point – Gloucester 230 kV line #1 & Eagle Point 230 kV line #2
- Gloucester 230 kV line #2
- Expedite the 2016 baseline upgrade B1588 from 2016 year to 2015 year
- If B1588 can't be expedited, establish operating procedures and/or a protection scheme(s) to alleviate the element loading until B1588 goes in service.
- Estimated Project Cost: \$25M
- Expected IS date: 6/1/2015





# PECO Transmission Zone

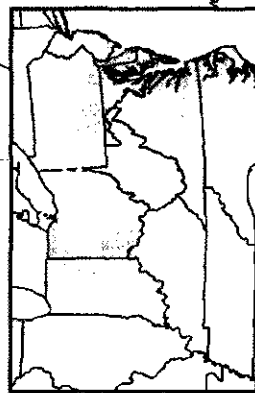
- Generation Deliverability
- Croydon - Burlington 230 kV line
- Replace aerial wire in Croydon substation (existing base line upgrade b1197 incorporates this requirement)
- Cost Estimate \$30K
- Expected IS date: 6/1/2015





# Genon (New Castle) Deactivations

- New Castle 3, 4, & 5; New Castle Diesels A & B
- Requested deactivation date: 4/16/2015



Kiesters

Wood Quality SteelForge Masters  
Cedar Street

New Castle

AT&T

Hoydale

Koppel Steel

Seneca

Zellenople Boro Maple

## LEGEND

• Subs Identified Transmission Lines

### Substations

|          |   |        |
|----------|---|--------|
| • 115 kV | ✓ | 69     |
| • 138 kV | ✓ | 115 kV |
| • 230 kV | ✓ | 138 kV |
| • 345 kV | ✓ | 230 kV |
| • 500 kV | ✓ | 345 kV |
| • 69 kV  | ✓ | 500 kV |
| • 765 kV | ✓ | 69 kV  |
|          | ✓ | 765 kV |
|          | ✓ | HVDC   |

EEP

East Liverpool  
J&L Furnace  
Midland  
Menfield

Raccoon

St. Joe M

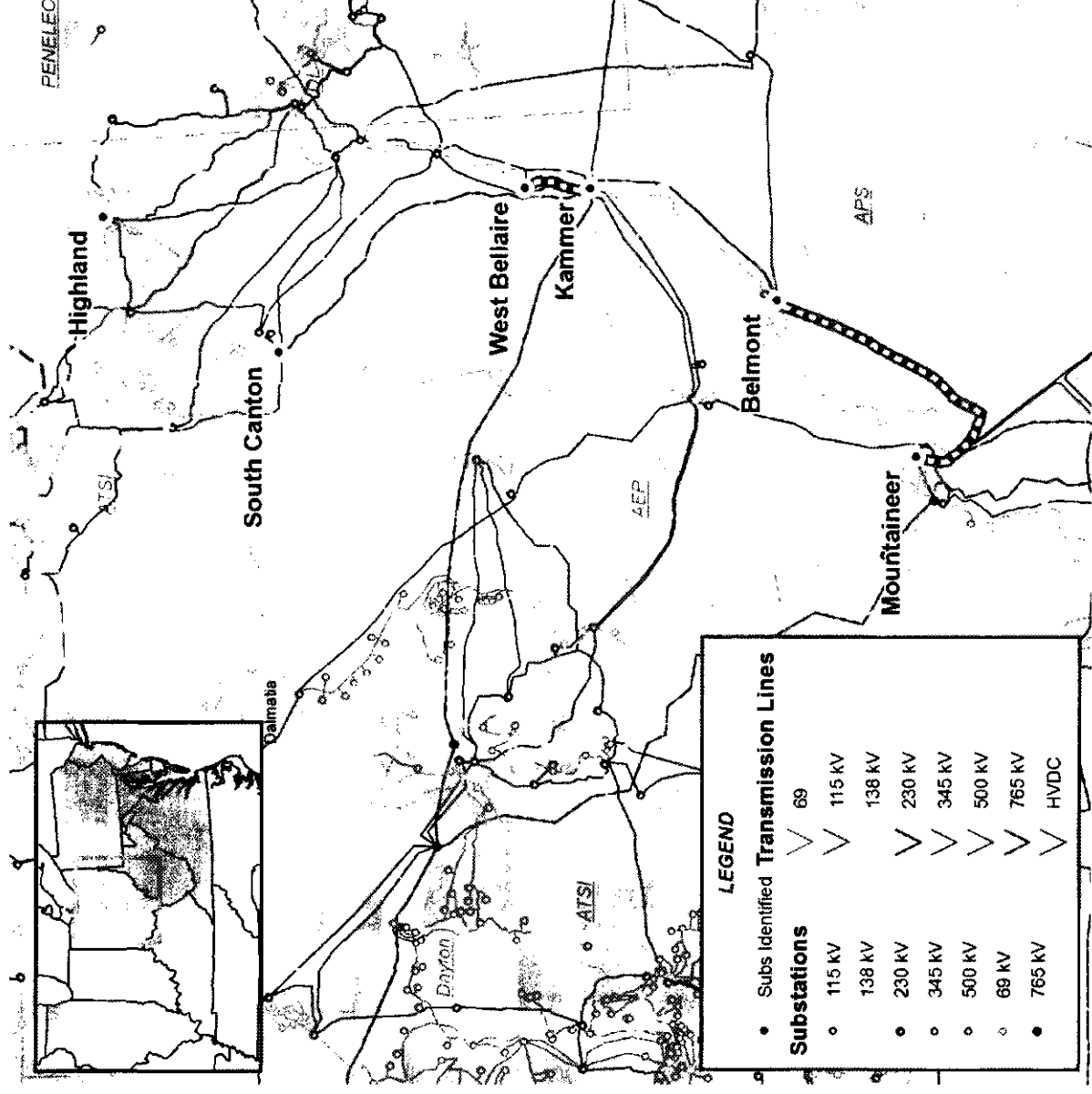
Aetna

Koppel Steel



# GenOn (New Castle) Deactivations

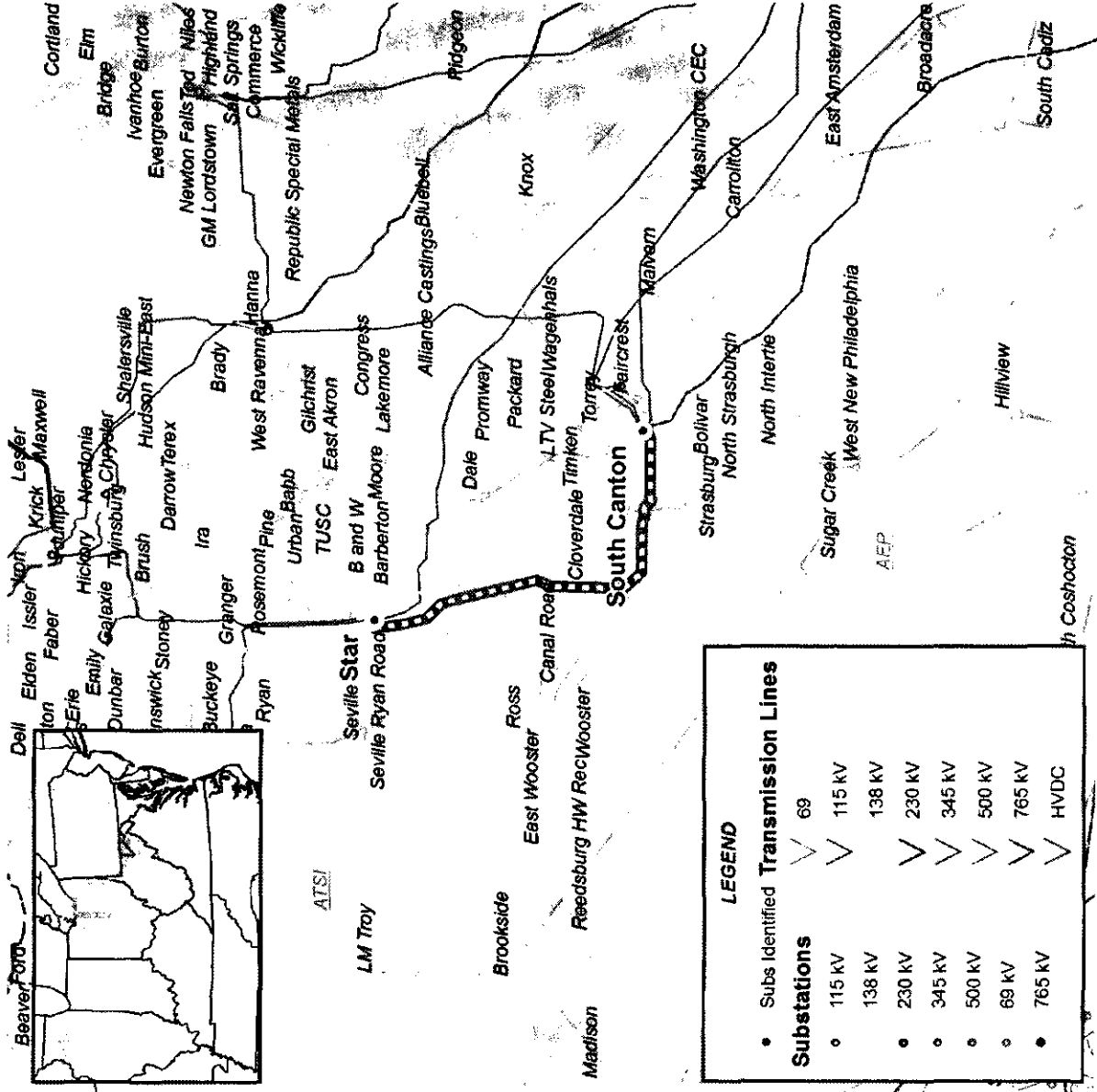
- Criteria violations
  - N-1 Thermal
  - N-1-1 Voltage and Thermal
  - Generation Deliverability
  - Load Deliverability
- Multiple 138kV and 345 kV bus voltage violations
- Multiple 138kV thermal violations
- Kammer-West Bellaire 345kV thermal violation
- Highland – G689 345 kV thermal violation
- South Canton - Harmon 345 kV line thermal violation (AEP-ATSI)
- Mountain - Belmont 765 kV line thermal violation
- South Canton 765/345 kV transformer thermal violation
- See subsequent slides for upgrades





# AEP Transmission Zone Reinforcement

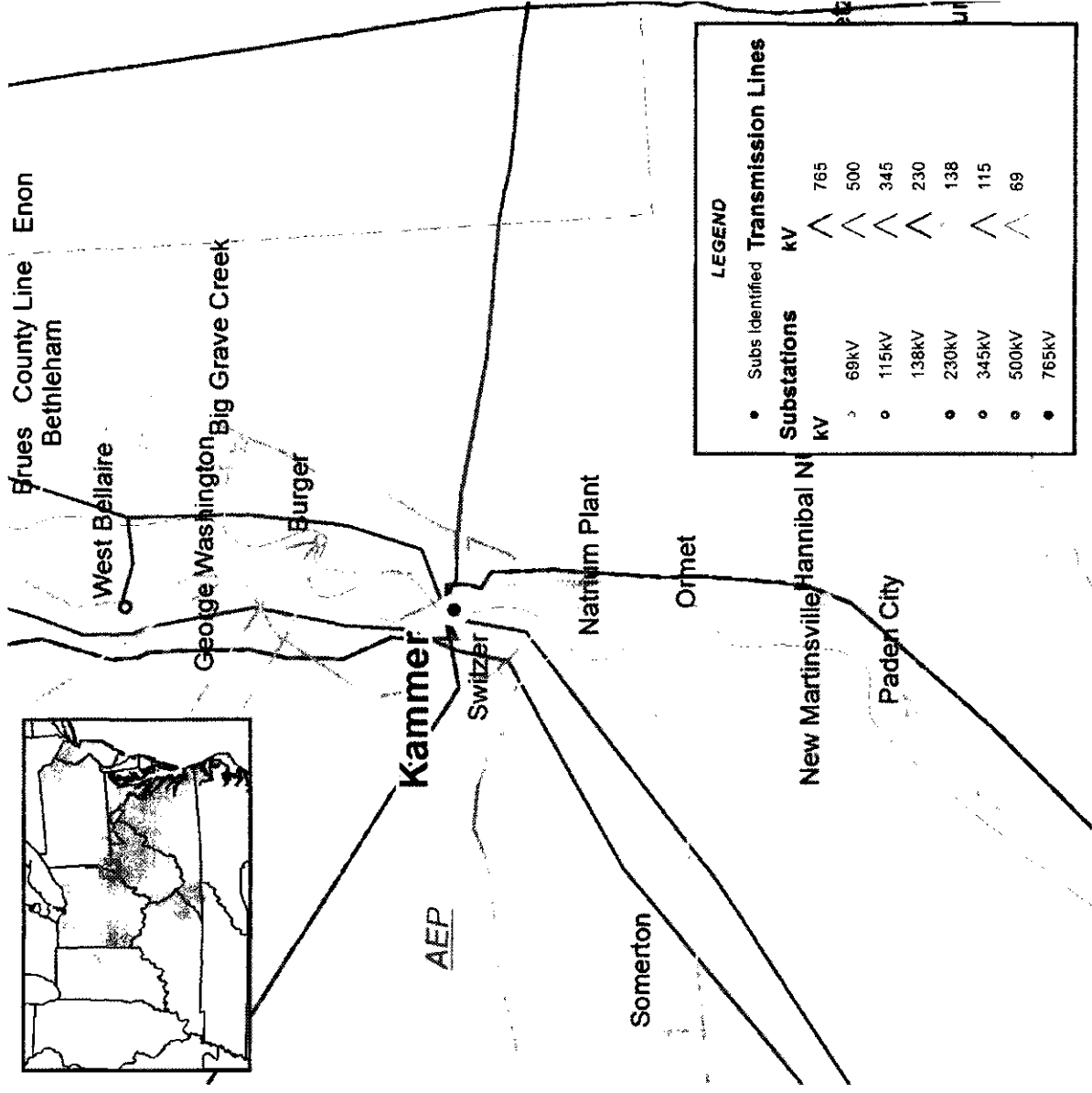
- The study of these projects aggravates overload as previously identified for Armstrong 1 & 2; Ashtabula 5; Bayshore 2-4; Eastlake 1-5; Lake Shore 18; R Paul Smith 3 & 4
- South Canton – Harmon 345 kV line Advance 2016 Baseline project B1812 (rebuild AEP portion of line). Also upgrades risers, wavetraps and bus work at South Canton station.
- Estimated Project Cost: \$2M
- Projected in-service date: 6/1/2015.





# AEP Transmission Zone Reinforcement

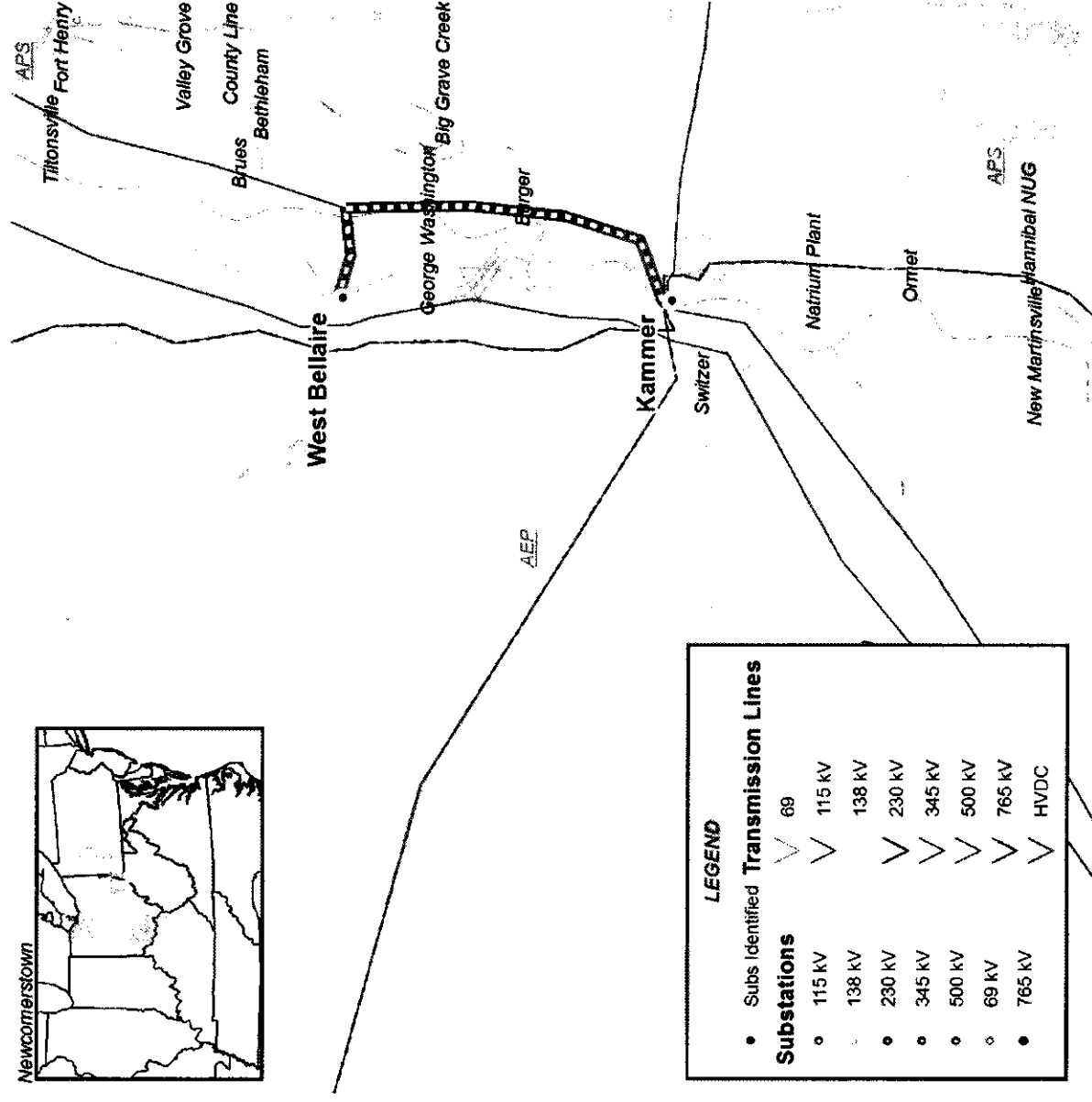
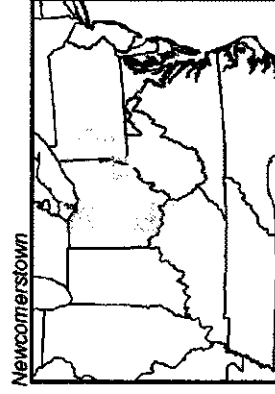
- The study of these projects aggravates overload as previously identified for Niles 1 & 2; Elrama 1, 2, 3 & 4
- The Belmont #1 765/500kV transformer overloads to 117.11% for the stuck breaker contingency  
'4831\_C2\_05KAMMER 765-NN'
- Add four 765 kV breakers at Kammer remove stuck breaker contingency which causes several violations
- Estimated Project Cost: \$30M
- Projected in-service date: 6/1/2015.





# AEP Transmission Zone Reinforcement

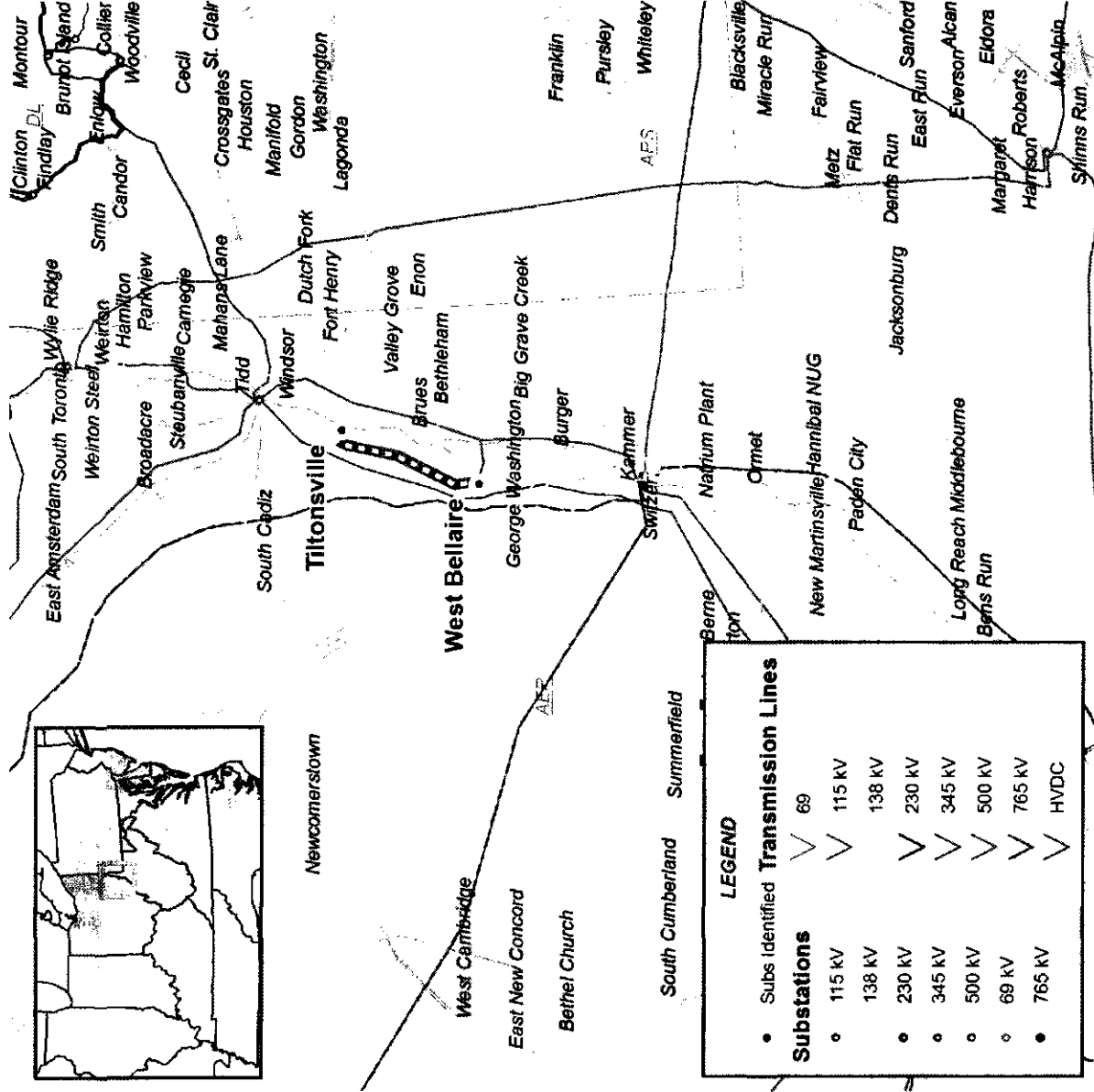
- The Kammer – West Bellaire 345 kV line loads to 118.55% for the single contingency loss of Kammer - S. Canton 765kV
- Reconducter 13 miles of the Kammer – West Bellaire 345kV circuit
- Estimated Project Cost: \$20M
- Projected in-service date: 6/1/2014.





# AEP Transmission Zone Reinforcement

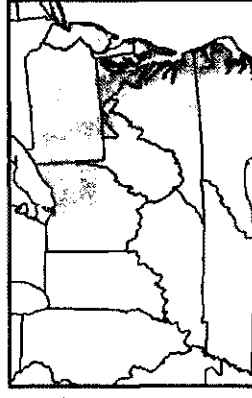
- The study of these projects aggravates overload as previously identified for Niles 1 & 2; Elrama 1, 2, 3 & 4
- Perform a Sag Study on section 1 (~12 miles) of the West Bellaire – Tiltonsville 138 kV line (existing base line upgrade b1457)
- Estimated Project Cost: \$.02M
- Projected in-service date to complete the sag study is 12/1/2012





# AEP Transmission Zone Reinforcement

- Newcomerstown-Hillsville 138kV loads to 112.9% of Rate A for loss of the Kammer – S.Canton 765 kV line + BASE CASE
- Sag study of Newcomerstown - Hillview 138 kV line. Upgrade terminal equipment (existing base line upgrade b1737)
- Estimated Project Cost: \$0.2M
- Projected in-service date: 12/01/2014.



Hillview

Newcomerstown

AEP

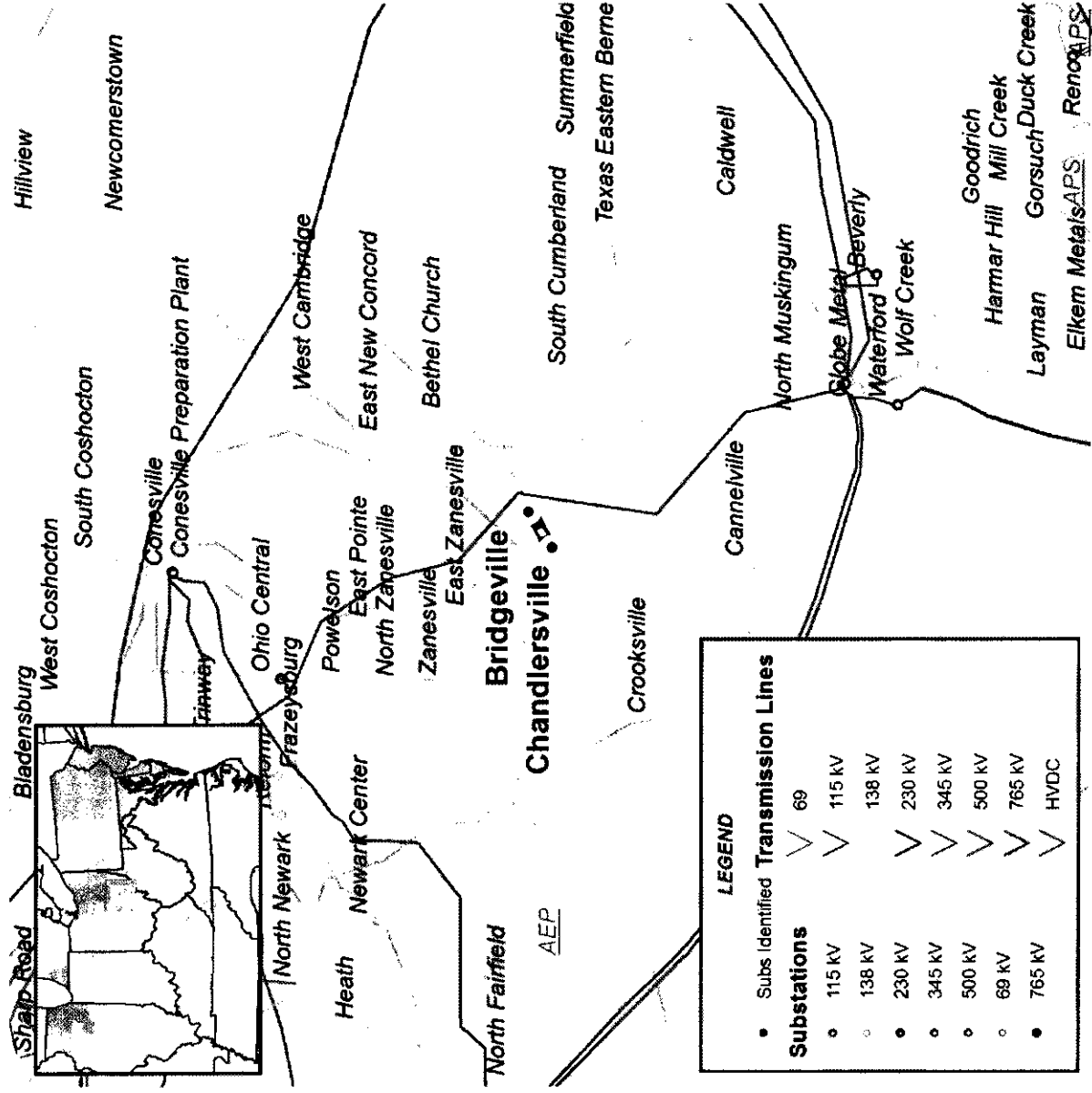
West Cambridge

| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| • 69kV            | 69                 |
| • 115 kV          | 115 kV             |
| • 138 kV          | 138 kV             |
| • 230 kV          | 230 kV             |
| • 345 kV          | 345 kV             |
| • 500 kV          | 500 kV             |
| • 765 kV          | 765 kV             |
|                   | HVDC               |



# AEP Transmission Zone Reinforcement

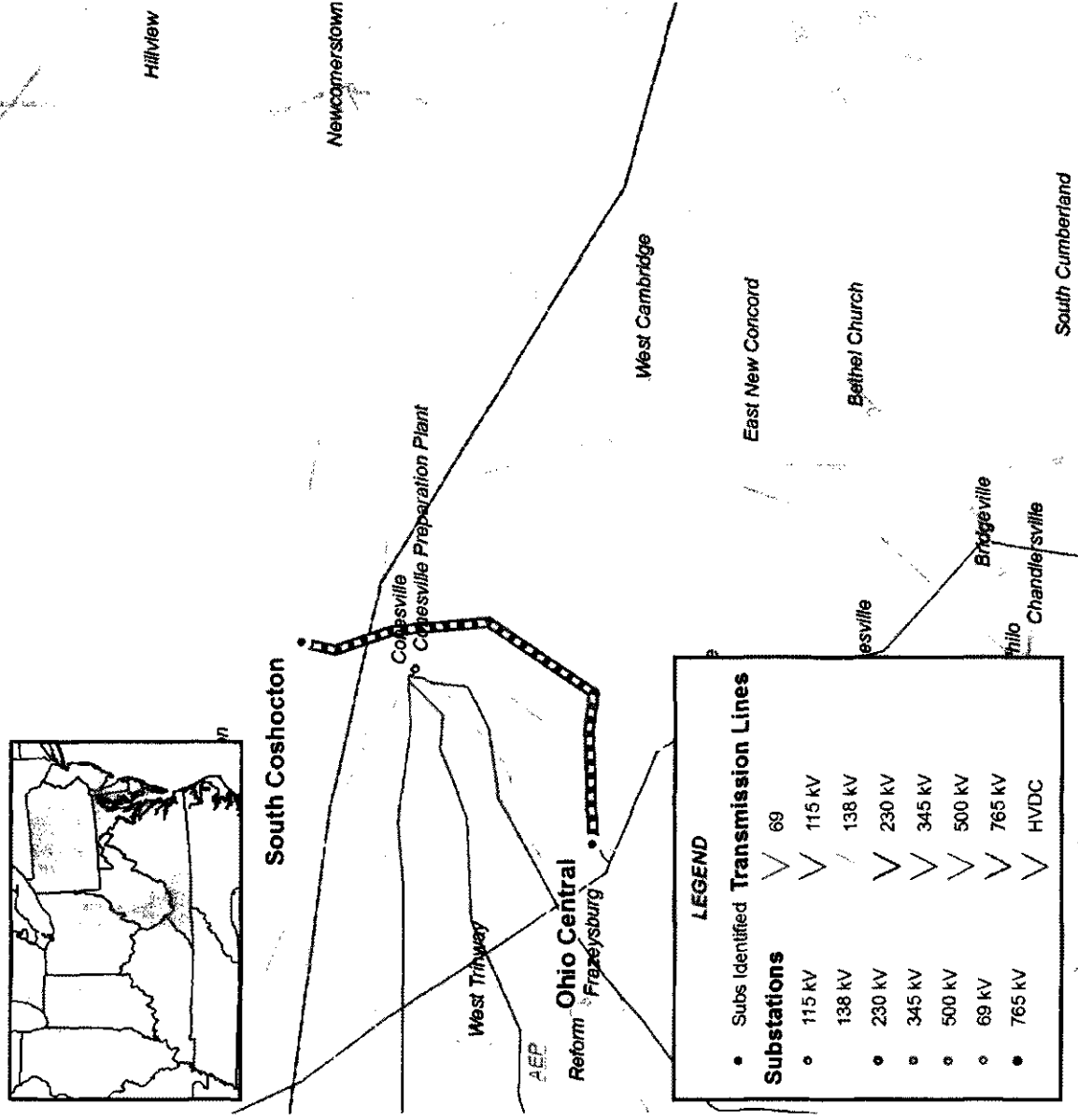
- The Bridgeville – Chandlersville 138 kV line is loaded to 110.2% of Rate B (185 MVA) for N-1-1 loss of loss of S.Canton – Tidd 345 kV line + the S.Canton – Kammer 765 kV line, S.Canton 765/345 kV transformer and S.Canton 345/138 kV transformer #4
- Perform a sag study to improve the emergency rating on the Bridgeville – Chandlersville 138 kV line
- Estimated Project Cost: \$50K
- Projected in-service date: 12/01/2014.





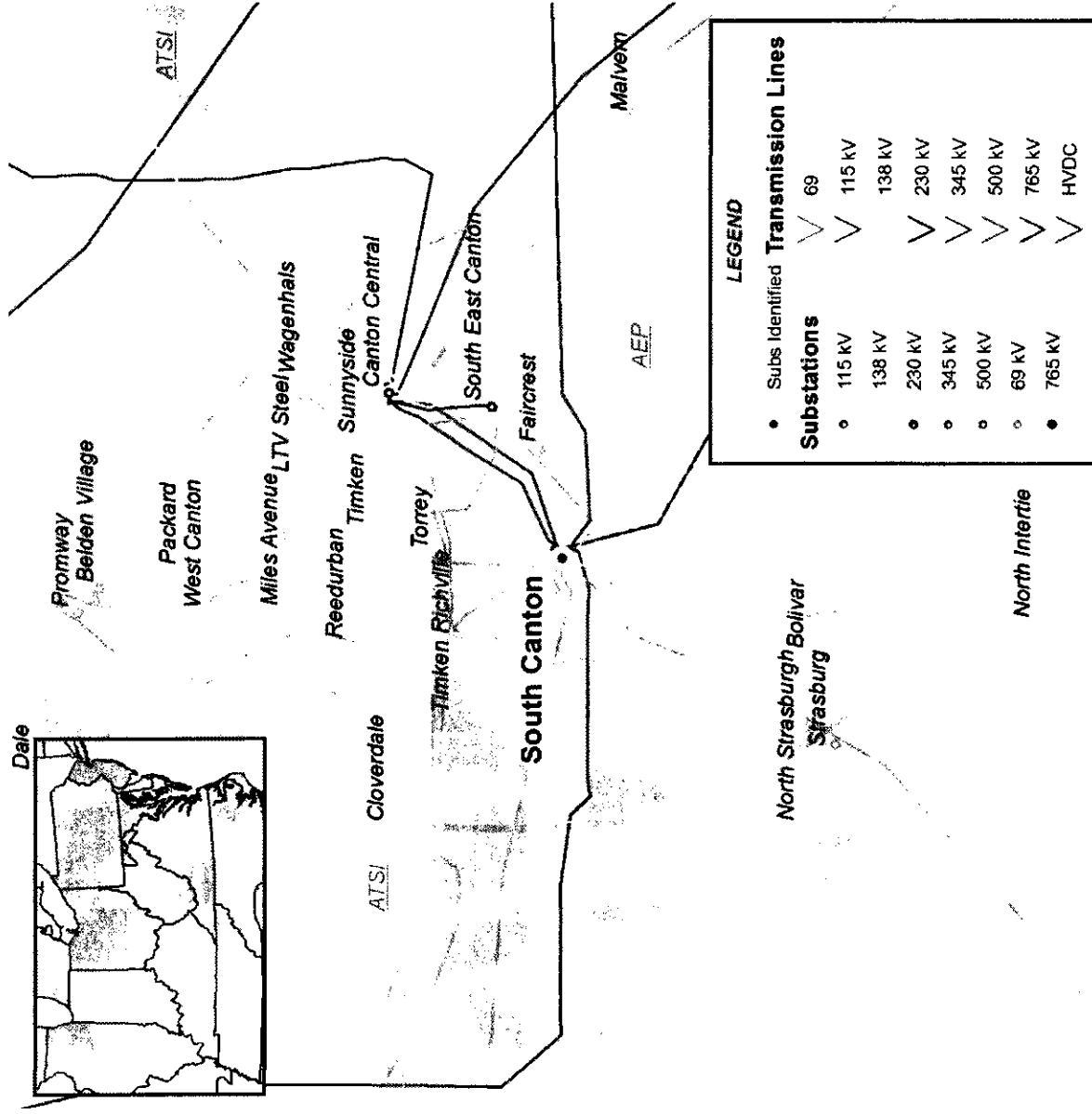
# AEP Transmission Zone Reinforcement

- Perform a sag study of the Ohio Central – South Coshocton 138 kV circuit (existing baseline upgrade b1869)
- Estimated Project Cost: \$0.07M
- Projected in-service date: 12/01/2014.





# AEP Transmission Zone Reinforcement

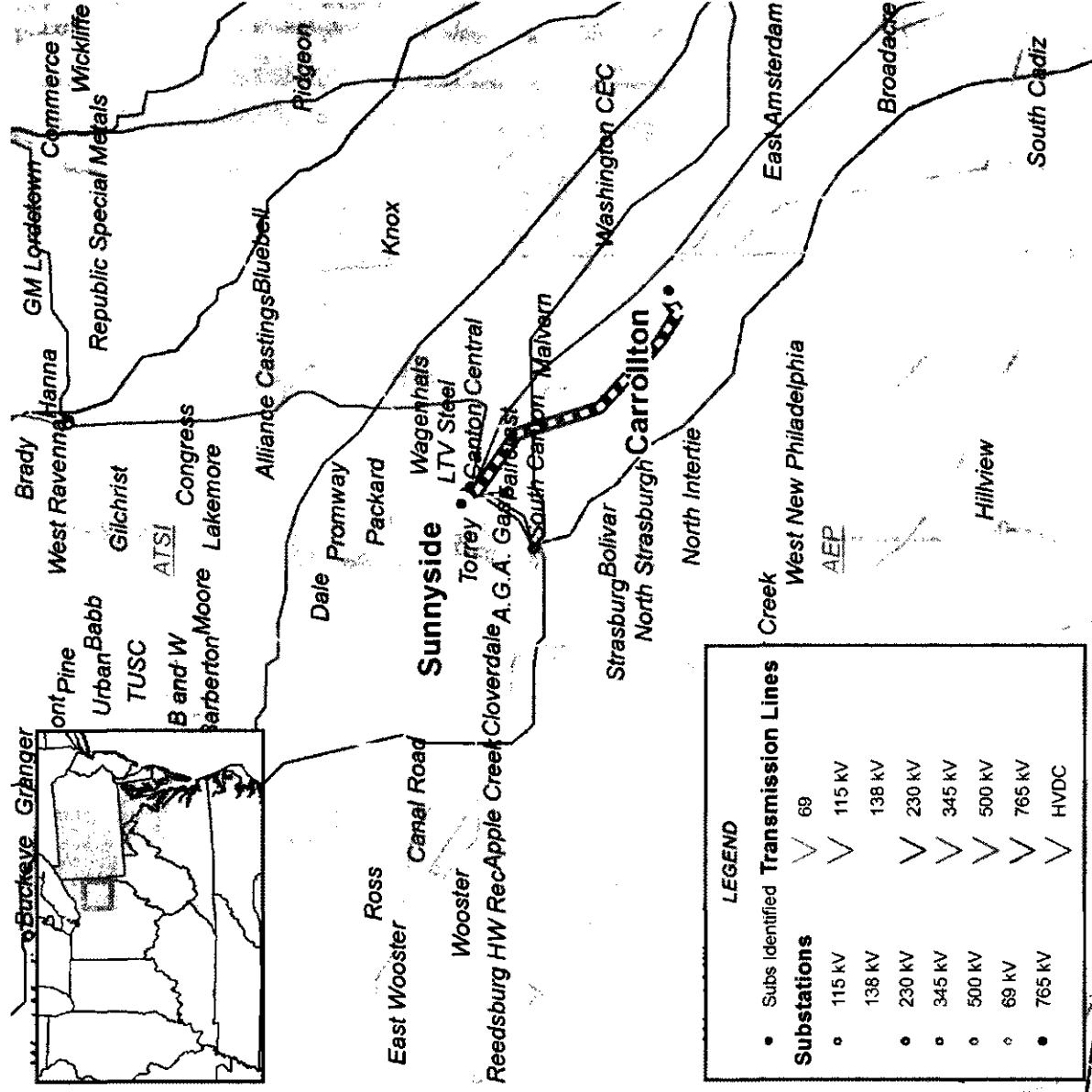


- The South Canton 765/345 kV transformer loads to 108.72% of its normal rating (1852 MVA) for the single contingency loss of the Perry generating unit.
- Replace disconnect switch on the South Canton 765/345 kV transformer
- Estimated Project Cost: \$300K
- Projected in-service date: 12/01/2014.



# AEP Transmission Zone Reinforcement

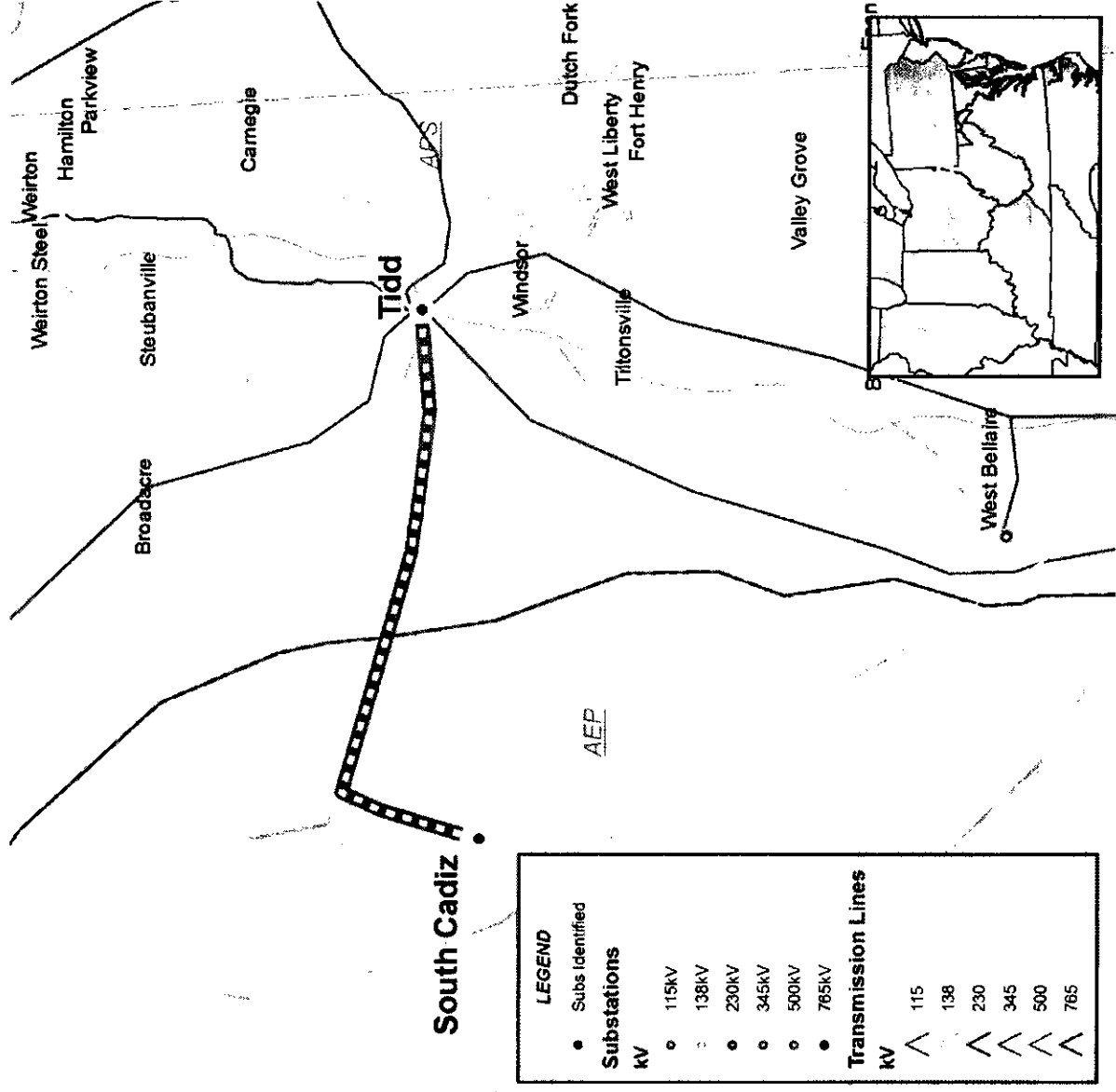
- Carrollton – Sunnyside 138 kV loads to 106.3% of rate B for N-1-1 loss of the S.Canton – Kammer 765 kV line, S.Canton 765/345 kV transformer and S.Canton 345/138 kV transformer #4 + loss of S.Canton – Tidd 345 kV line
- Perform a sag study to improve the emergency rating on the Carrollton – Sunnyside 138 kV line
- Estimated Project Cost: \$50K
- Projected in-service date: 12/01/2014.





# AEP Transmission Zone Reinforcement

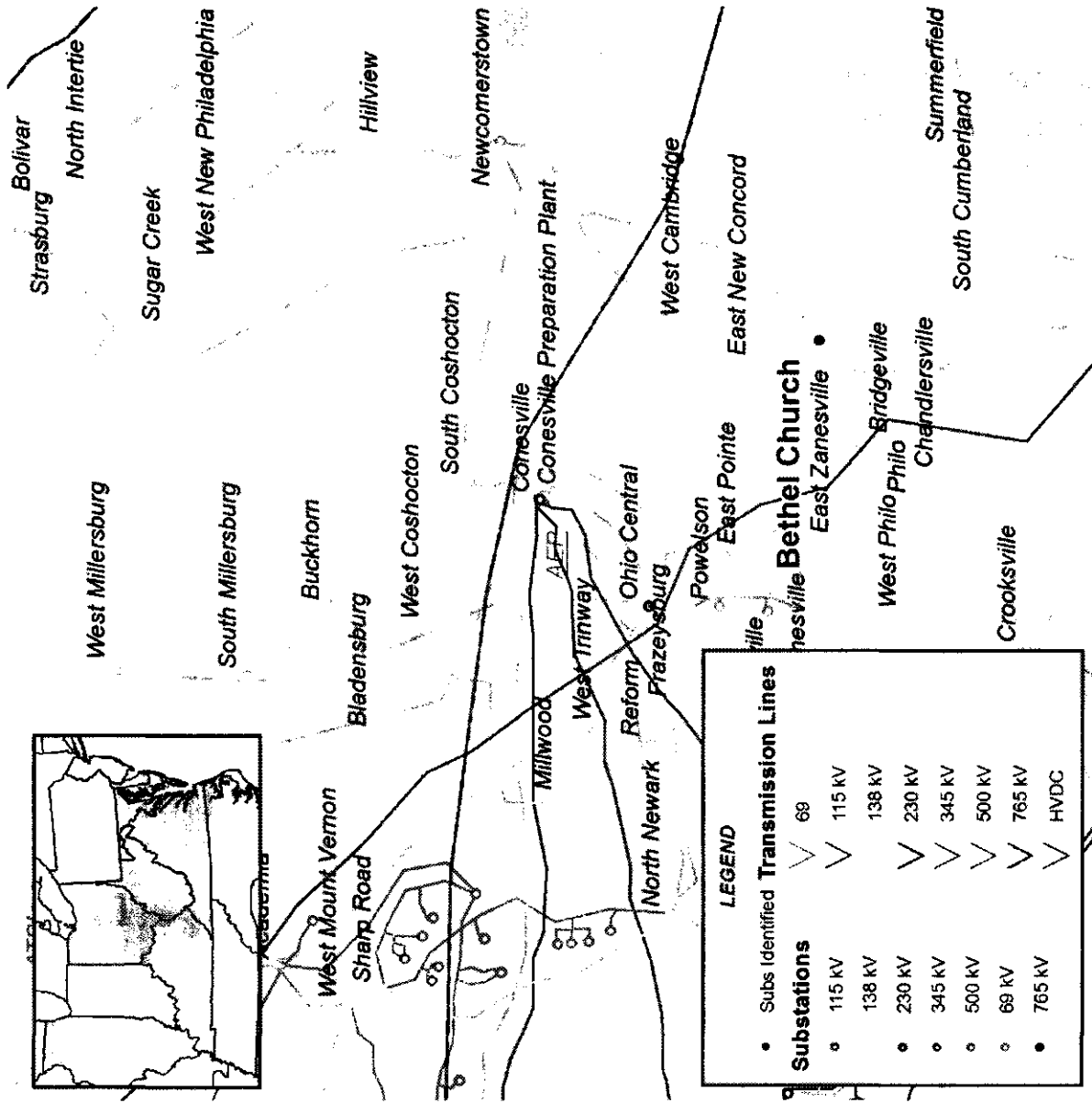
- South Cadiz -Tidd 138 kV loads to 104% of Rate B for N-1-1 : loss of the S.Canton – Kammer 765 kV line, S.Canton 765/345 kV transformer and S.Canton 345/138 kV transformer #4 + loss of S.Canton – Tidd 345 kV line
- Replace relays at both South Cadiz 138 kV and Tidd 138 kV (existing baseline upgrade b1462)
- Estimated Project Cost: \$0.5M
- Projected in-service date: 12/01/2014





# AEP Transmission Zone Reinforcement

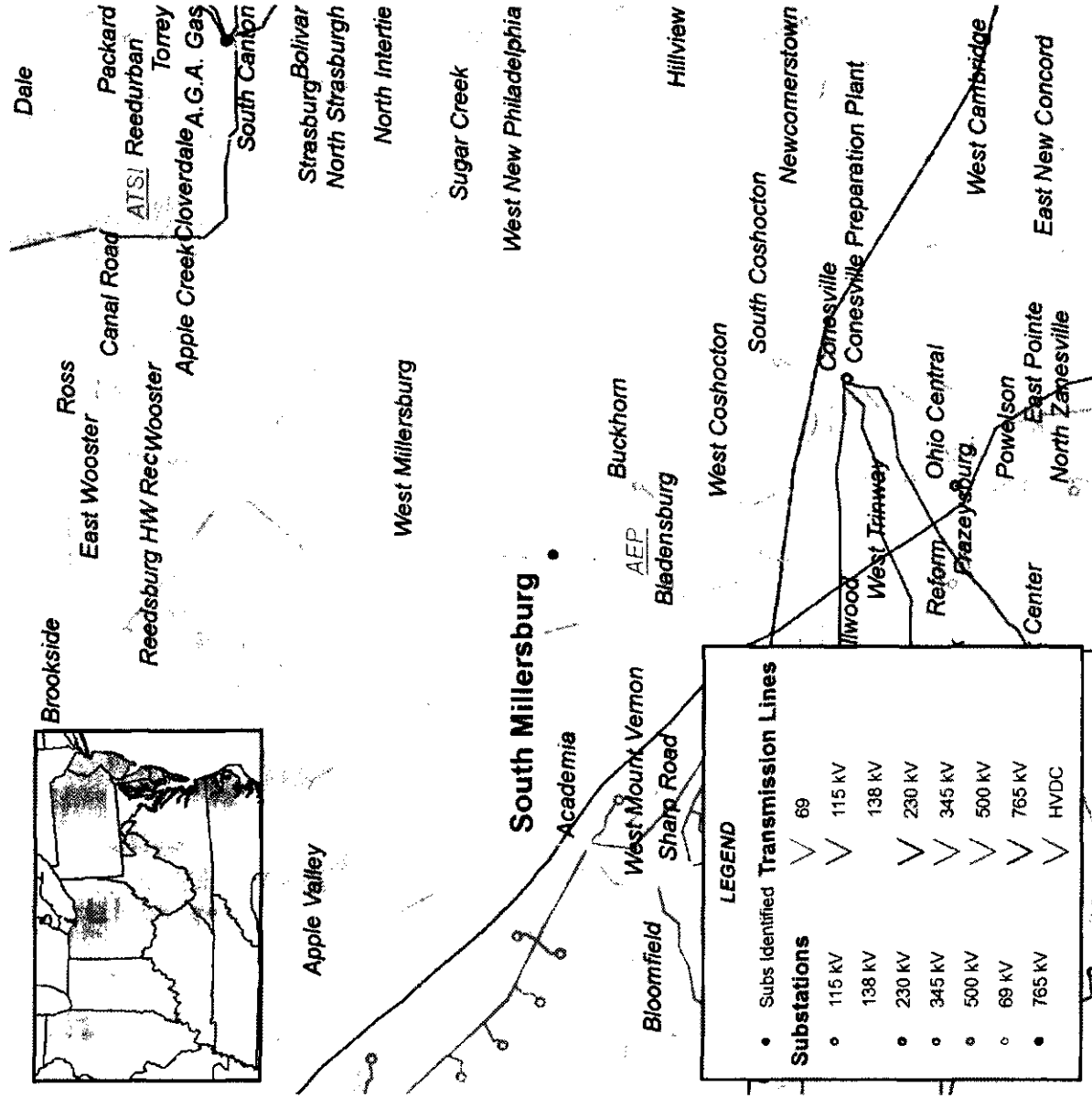
- Bethel Church – West Dover 138 kV loads to 100.4% of Rate B for N-1-1 : S.Canton – Tidd 345 kV line + loss of the S.Canton – Kammer 765 kV line, S.Canton 765/345 kV transformer and S.Canton 345/138 kV transformer #4
- Perform a sag study to improve the emergency rating on the Bethel Church – West Dover 138 kV line
- Estimated Project Cost: \$25K
- Projected in-service date: 12/01/2014.





# AEP Transmission Zone Reinforcement

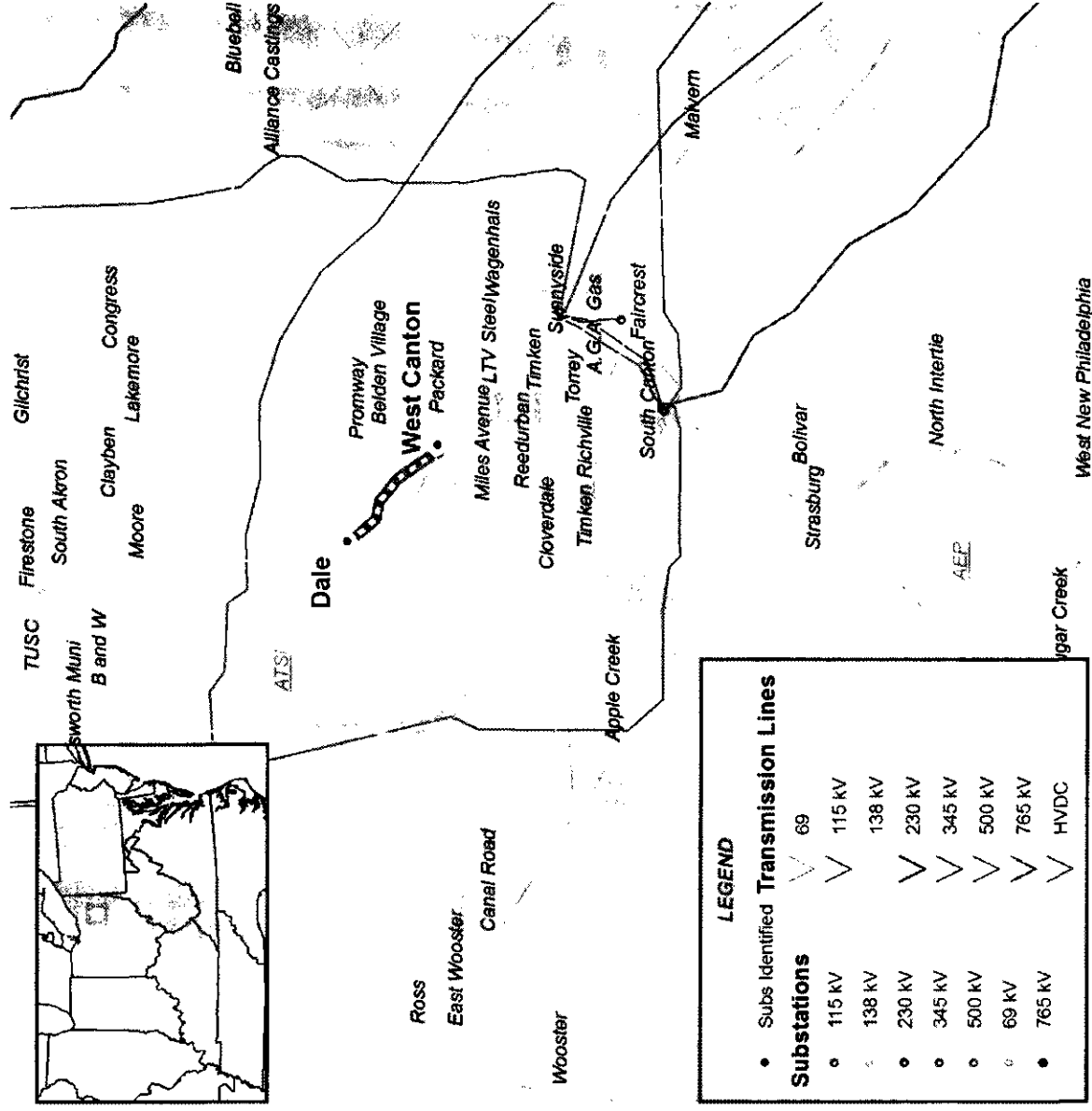
- The Buckhorn – South Millersburg 138 kV lin is loaded to 105.8% of Rate A (148 MVA) for N-1-1 loss of the S.Canton 765/345 kV transformer #3 + BASE CASE
- Replace a switch at South Millersburg switch station
- Estimated Project Cost: \$200K
- Projected in-service is 12/01/2014.





# AEP Transmission Zone Reinforcement

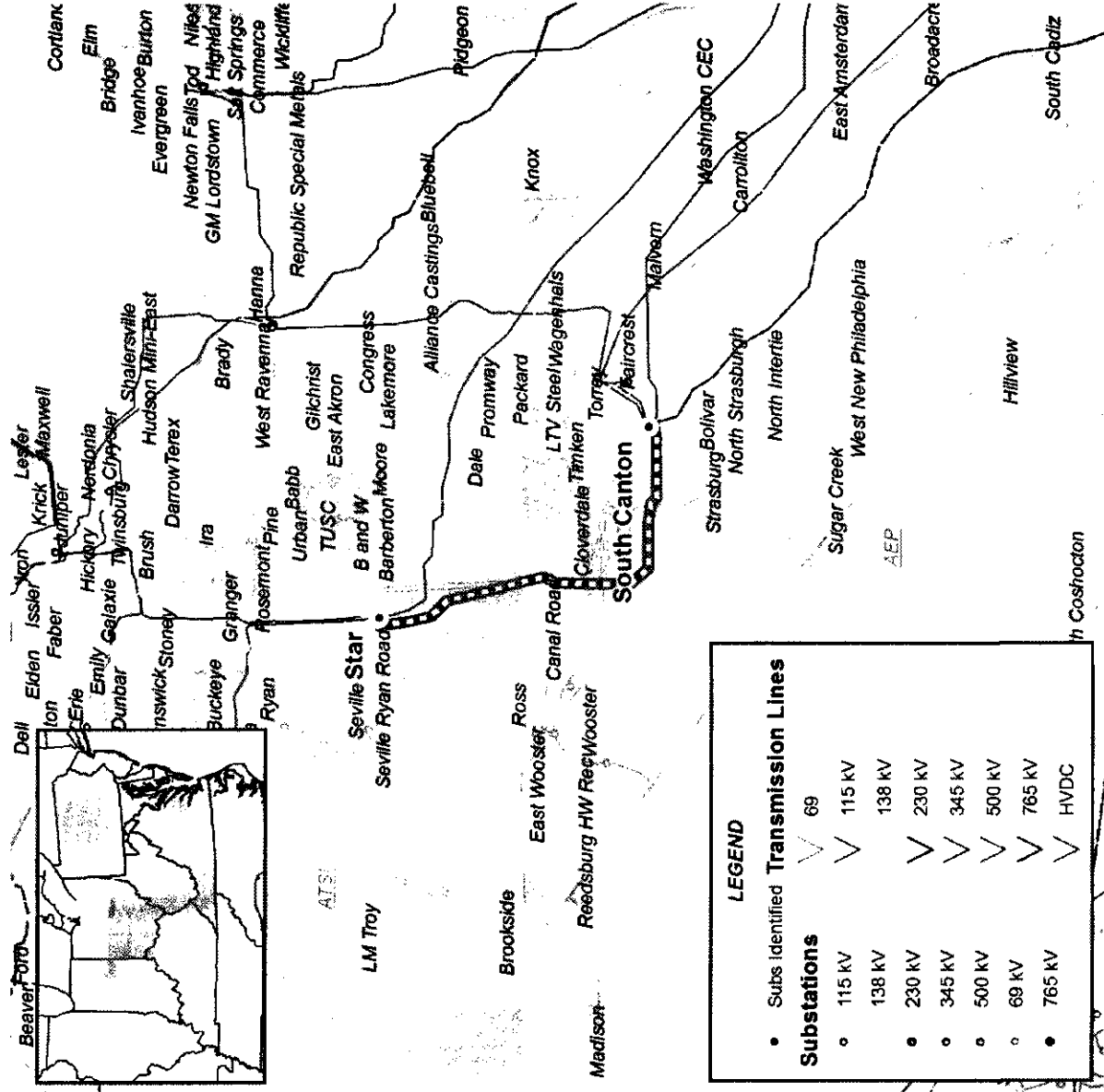
- Dale-West Canton 138kV loads to 103.3% of rate A for N-1-1: S.Canton – Harmon 345 kV line + Basecase.
- Reconductor 0.83 miles of the Dale-West Canton 138kV Tie-line and upgrade risers at West Canton 138kV (existing baseline upgrade b1861)
- Estimated Project Cost: \$1.7M
- Projected in-service is 6/01/2014.





# ATSI Transmission Zone Reinforcement

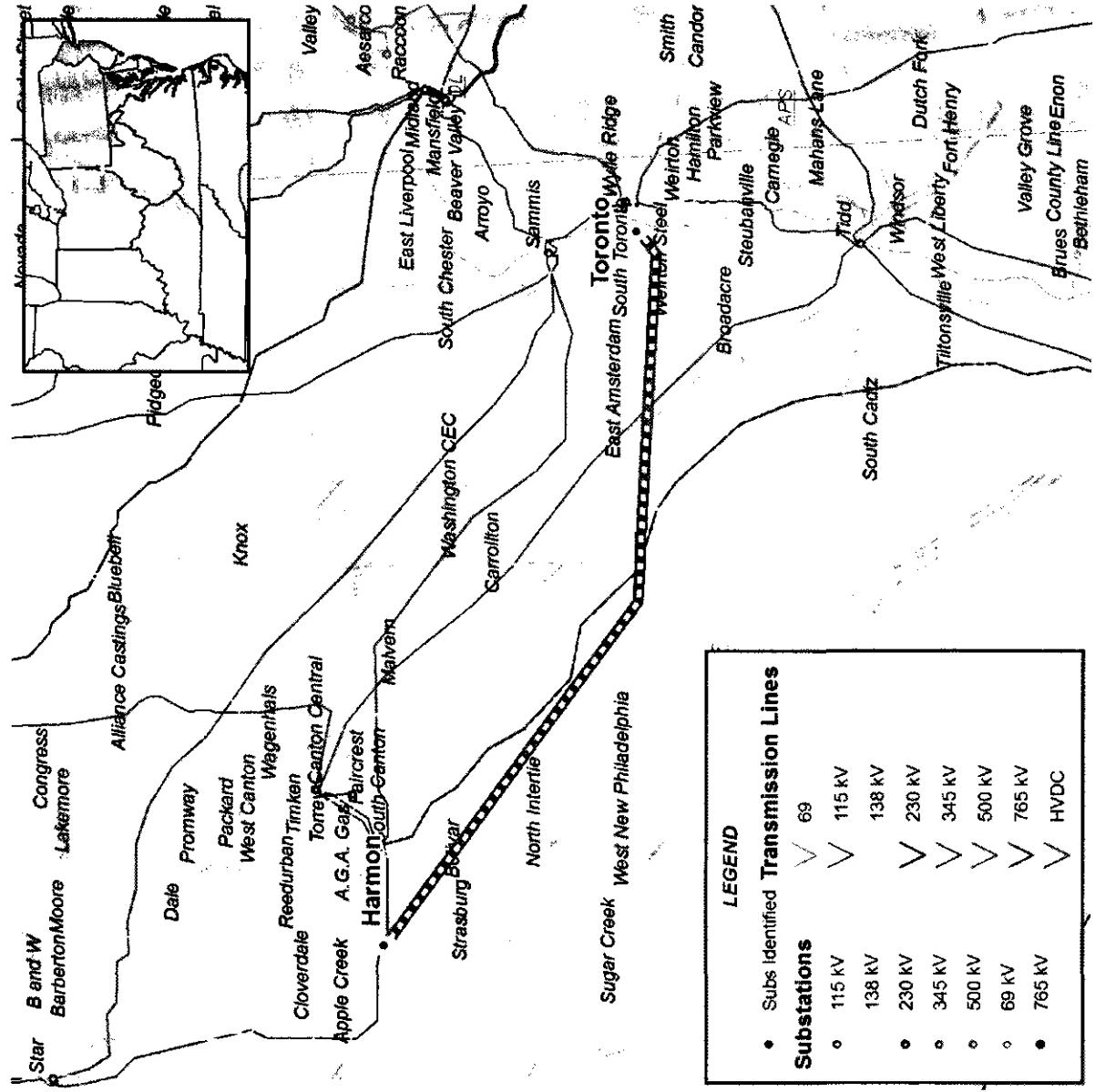
- The South Canton – Harmon 345 kV line (tie line between AEP & ATSI) loads to 110.94% of its normal rating (1409 MVA) for the loss of the Sammis – Star 345 kV line.
- Reconducter ATSI portion of South Canton – Harmon 345 kV line
- Estimated Project Cost: \$6M
- Projected in-service date: 6/1/2015.





## ATSI Transmission Zone Reinforcement

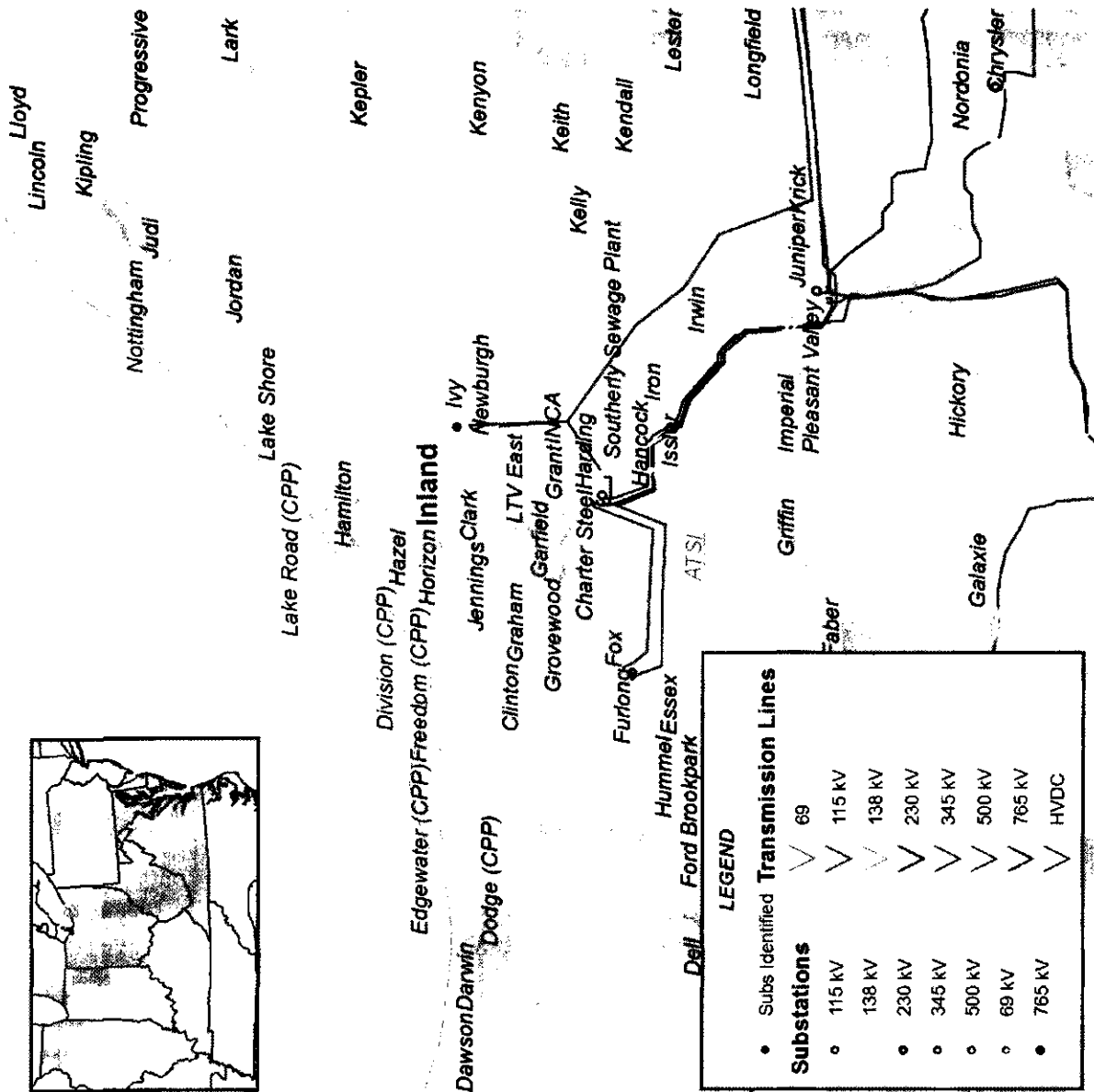
- The Dale West Canton 138kV line loads to 109.4% for N-1-1: Loss of S. Canton – Harmon 345 kV line + 'BASE CASE' & the Bluebell – Cantonc 138 kV line loads to 117.6% for N-1-1: Loss of the S. Canton – Harmon 345 kV line + loss of the + S. Canton – Hanna 345 kV line.
- Build new Toronto 345/138 kV substation by looping in the Sammis – Wylie Ridge 345 kV line and tie in four 138 kV lines
- Estimated Project Cost: \$41.8M
- Build a new Toronto-Harmon 345kV line
- Estimated Project Cost: \$218.3M
- Projected in-service date: 6/1/2017.
- Short term
  - Open the Dale 138/69 kV transformer after the loss of the South Canton – Harmon 345 kV line.





# ATSI Transmission Zone Reinforcement

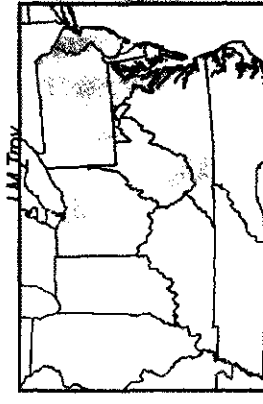
- The Inland – Clinic Health Q-11 138 kV line is loaded to 115.2% of Rate B (309 MVA) for the N-1-1 loss of the Eastlake 345/138 kV transformer #61 + loss of the Q-14-IN-CLE CLINIC 138 kV bus.
- Reconnector Inland – Clinic Health Q-11 138 kV line.
- Estimated Project Cost: \$1.1M
- Projected in-service date: 6/1/2015





# ATSI Transmission Zone Reinforcement

- Previously identified for Armstrong 1 & 2; Ashtabula 5; Bayshore 2-4; Eastlake 1-5; Lake Shore 18; R Paul Smith 3 & 4
- ATSI-AEP 138kV Substation on near territory border + 138kV from new substation to Longview approx. 8 miles
- Estimated Project Cost: \$17.7M
- Projected in-service date: 6/1/2016



AEP

Brookside

New Station

Howard

Shelby

Milliron

Combs

Longview

Ontario GM

Leaside

Madison

ATSI

AEP

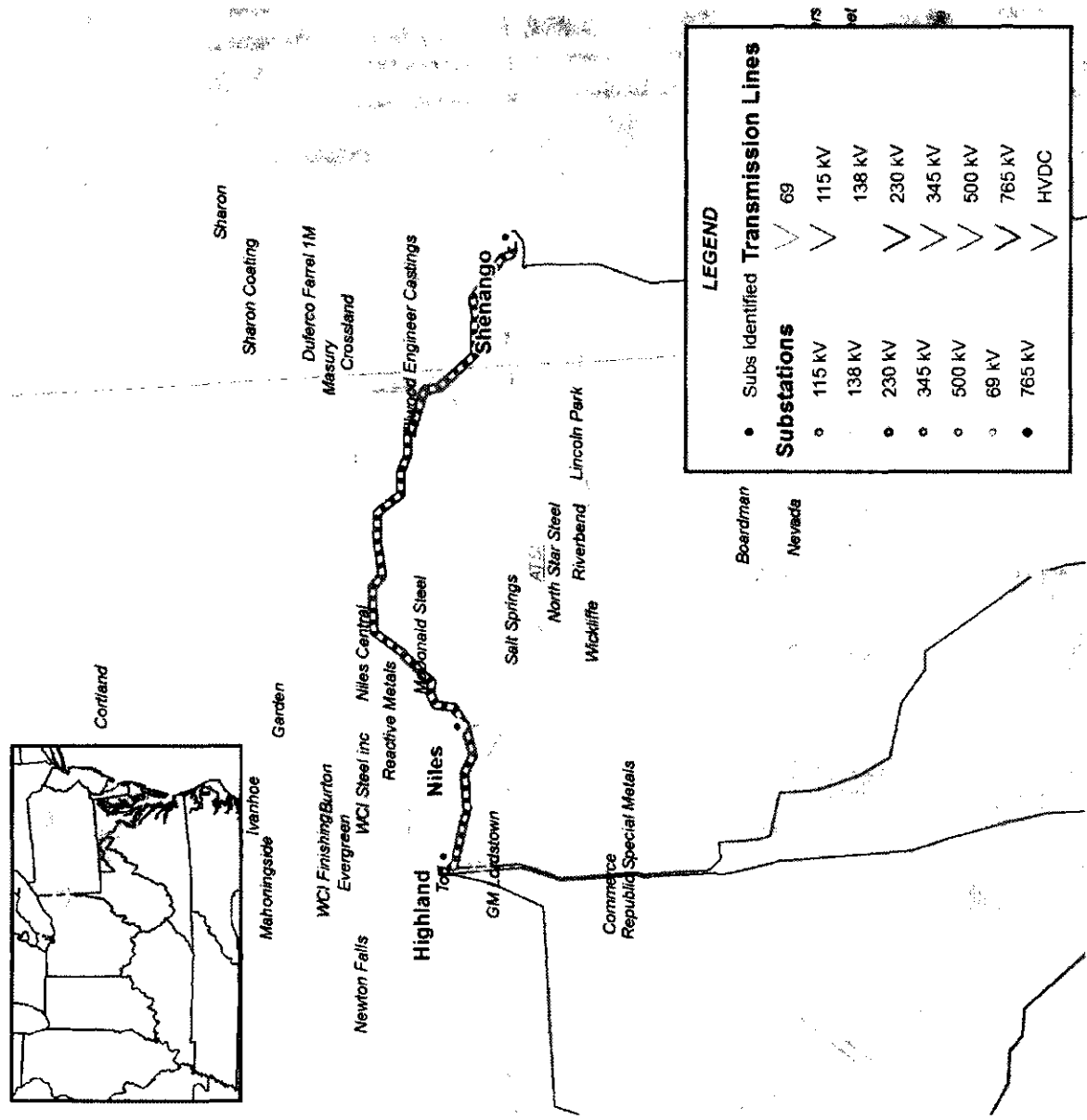
| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| Substations       | 69                 |
| • 115 kV          | 115 kV             |
| • 138 kV          | 138 kV             |
| • 230 kV          | 230 kV             |
| • 345 kV          | 345 kV             |
| • 500 kV          | 500 kV             |
| • 69 kV           | 765 kV             |
| • 765 kV          | HVDC               |

- 
- LEGEND**
- Subs Identified
- Transmission Lines**
- |        |        |
|--------|--------|
| 69     | 115 kV |
| 115 kV | 138 kV |
| 138 kV | 230 kV |
| 230 kV | 345 kV |
| 345 kV | 500 kV |
| 500 kV | 765 kV |
| 765 kV | HVDC   |



## ATSI Transmission Zone Reinforcement

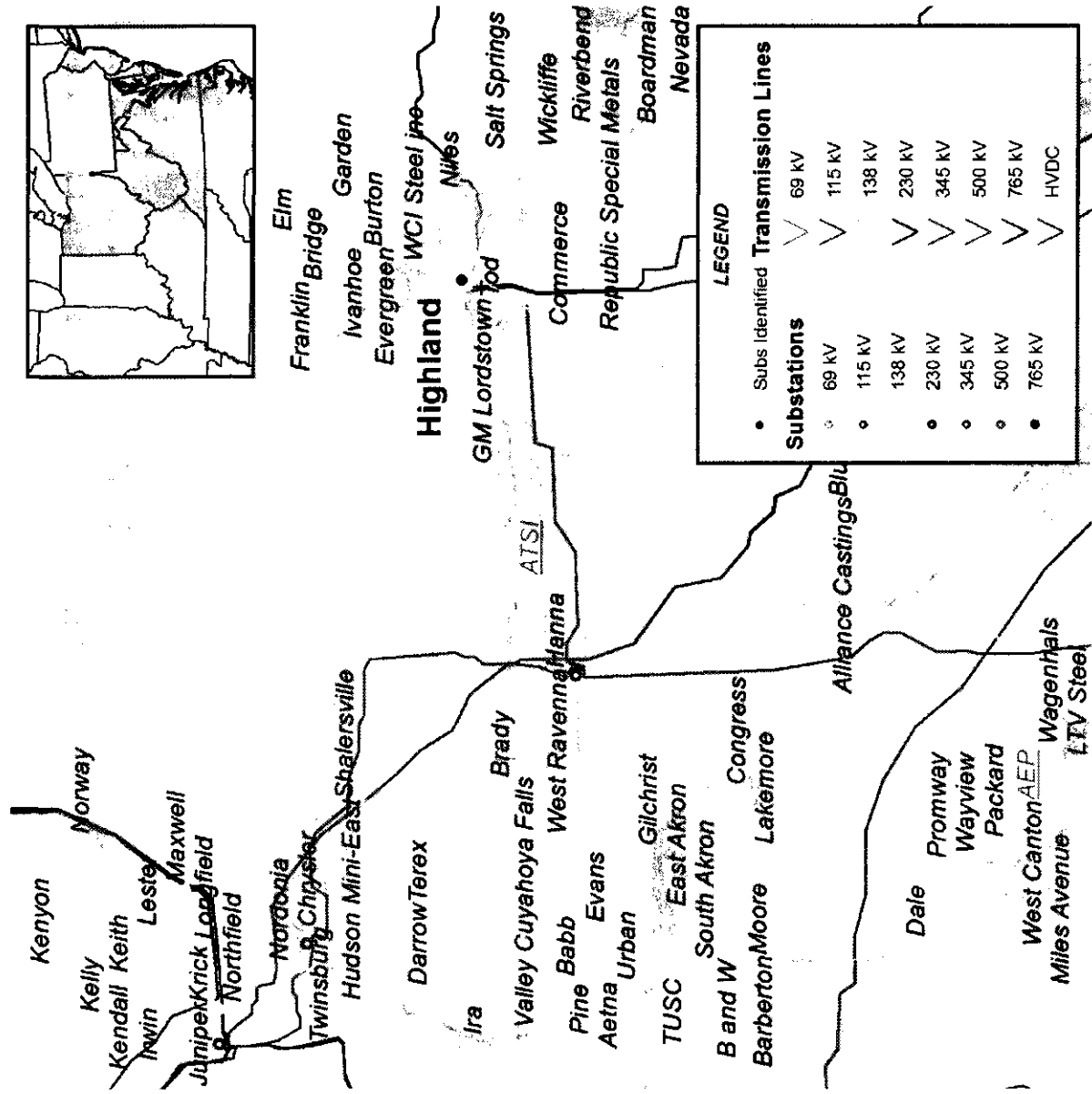
- The Highland – 02R.M.+ 138 kV line loads to 101.84% or the tower contingency loss of the Highland – Evergreen 138 kV lines #1 and #2.
- Build 345-138kV Substation at Niles. 1.2 mile 345kV loop of the Highland – Shenango 345 kV line into substation. New 345/138 kV transformer. Project also increased short circuit levels to benefit power quality due to multiple EAF loads in the area
- Same project as discussed in the FES deactivation section
- Estimated Project Cost: \$32M
- Projected in-service date: 6/1/2015.





# ATSI Transmission Zone Reinforcement

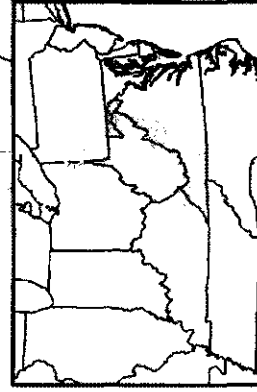
- The Highland – G689 345 kV line is loaded to 103.4% of Rate B (979 MVA) for the N-1-1 loss of the Hoytdale – Mansfield 345 kV line + Highland – Mansfield 345 kV line
- Replace relay on the Highland – G689 345 kV line
- Estimated Project Cost: \$0.05M
- Projected in-service date: 12/31/2012.





# ATSI Transmission Zone Reinforcement

- The Hoytdale – Newcastle 138 kV line #1 is loaded to 108.2% of Rate B (315 MVA) for the N-1-1 loss of the Hoytdale – Shenango 345 kV line + New Castle – Hoytdale 138 kV line #2
- The Hoytdale – Newcastle 138 kV line #2 is loaded to 108.5% of Rate B (309 MVA) for the N-1-1 loss of 930\_B2 + B\_LINE1\_ER\_001
- Reconnector the Hoytdale – Newcastle 138 kV lines #1 and #2 with 795 ACSS
- Estimated Project Cost: \$4.8M
- Projected in-service date: 6/1/2015.



Wood Quality SteelForge Masters

Cedar Street

New Castle

ATSI

Hoytdale

Koppel Steel

Seneca

Zellenapple Boro Maple

| LEGEND            |                    |
|-------------------|--------------------|
| • Subs Identified | Transmission Lines |
| • 115 kV          | 69                 |
| • 138 kV          | 115 kV             |
| • 230 kV          | 138 kV             |
| • 345 kV          | 230 kV             |
| • 500 kV          | 345 kV             |
| • 69 kV           | 500 kV             |
| • 765 kV          | 765 kV             |
|                   | HVDC               |

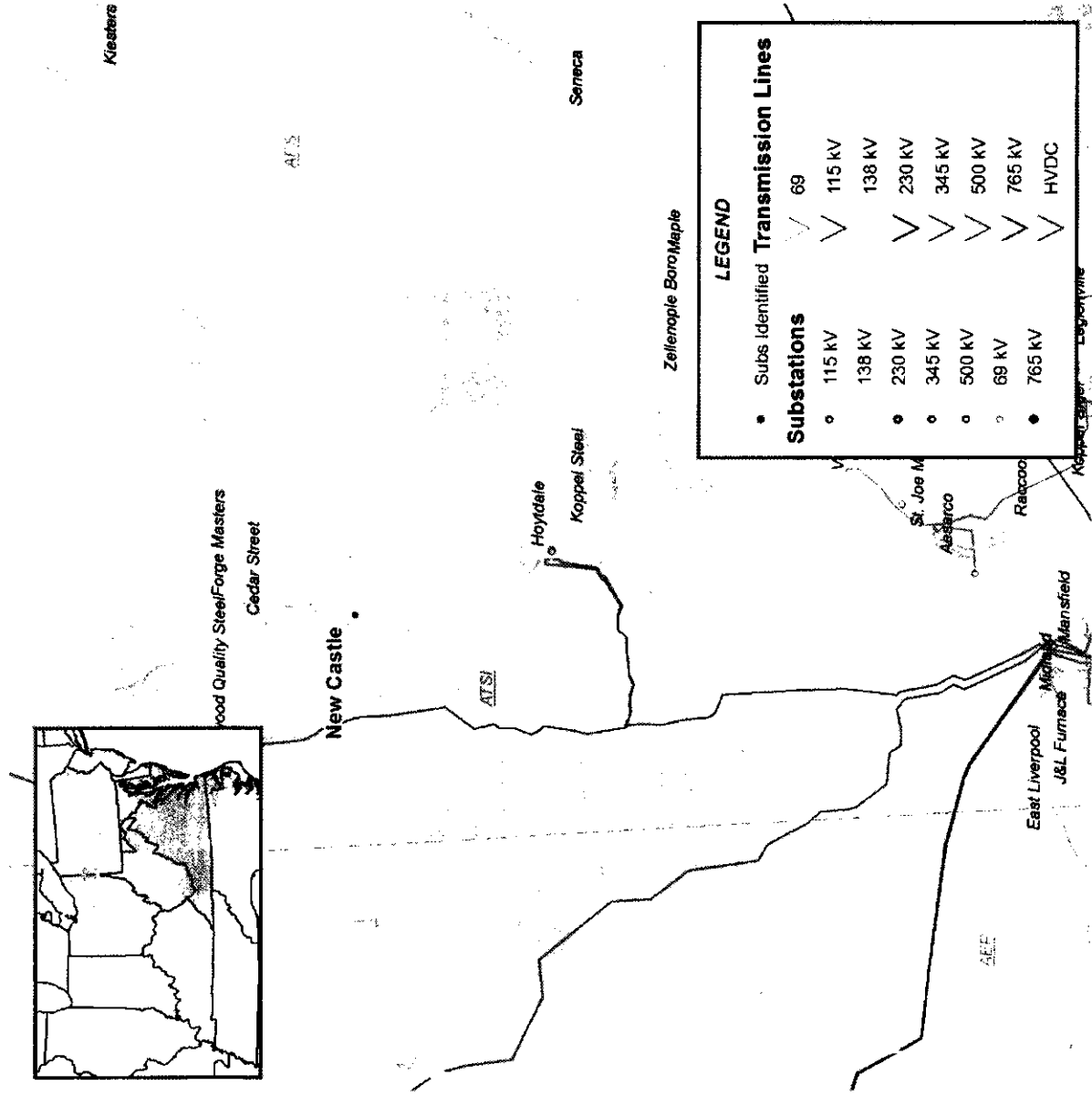
East Liverpool  
J&L Furnace  
Midland  
MansfieldKoppel Steel  
Seneca  
Zellenapple Boro Maple



# ATSI Transmission Zone Reinforcement

- The Hoytdale 138 kV bus voltage drop is 8.21% for the N-1-1 loss of Highland – Shenango 345 kV line + loss of the Hoytdale – Mansfield 345 kV line.
- Add 150 MVAR SVC and a 100 MVAR capacitor at New Castle

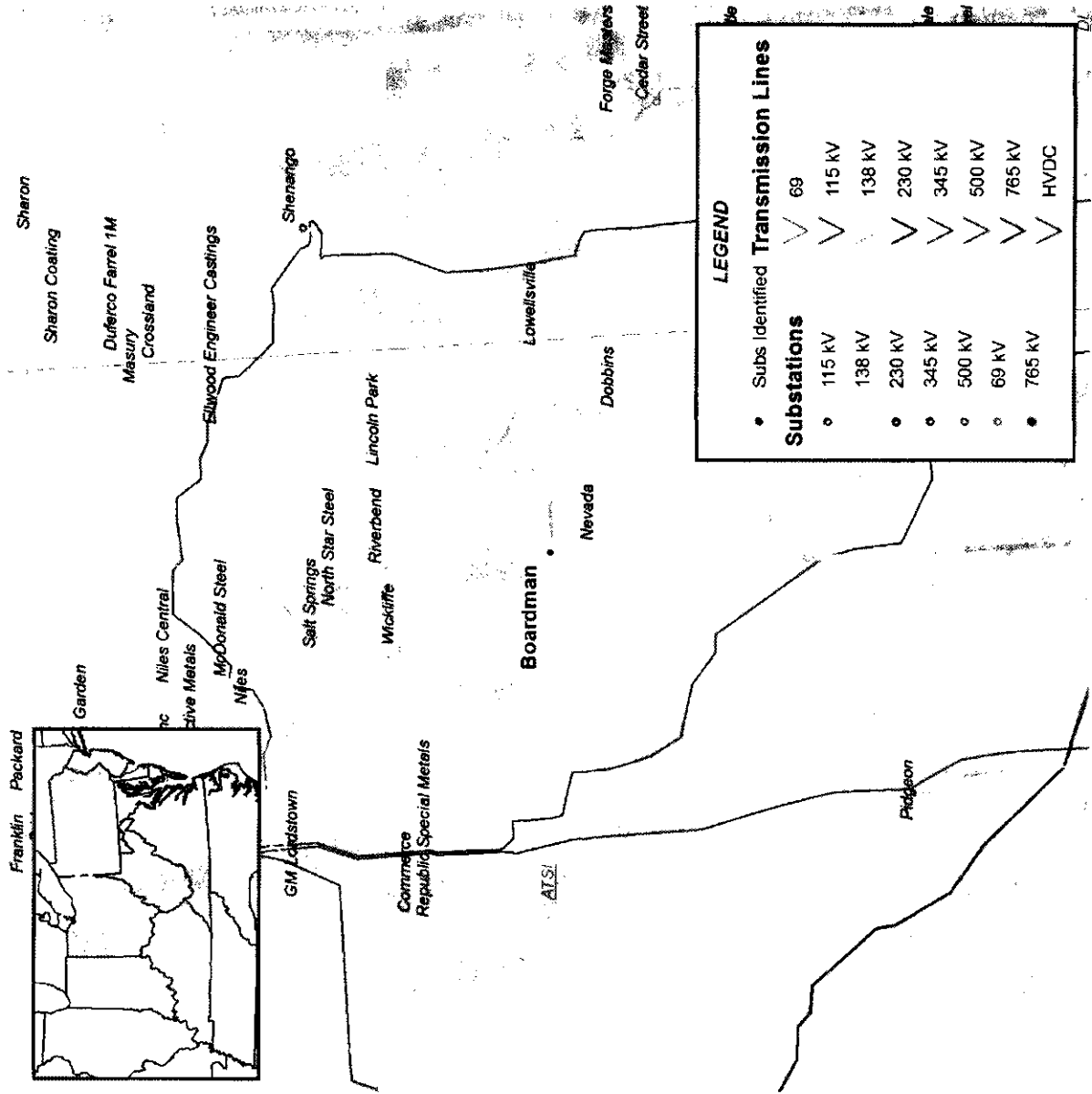
- Estimated Project Cost: \$31.7M
- Projected in-service date: 6/1/2015.





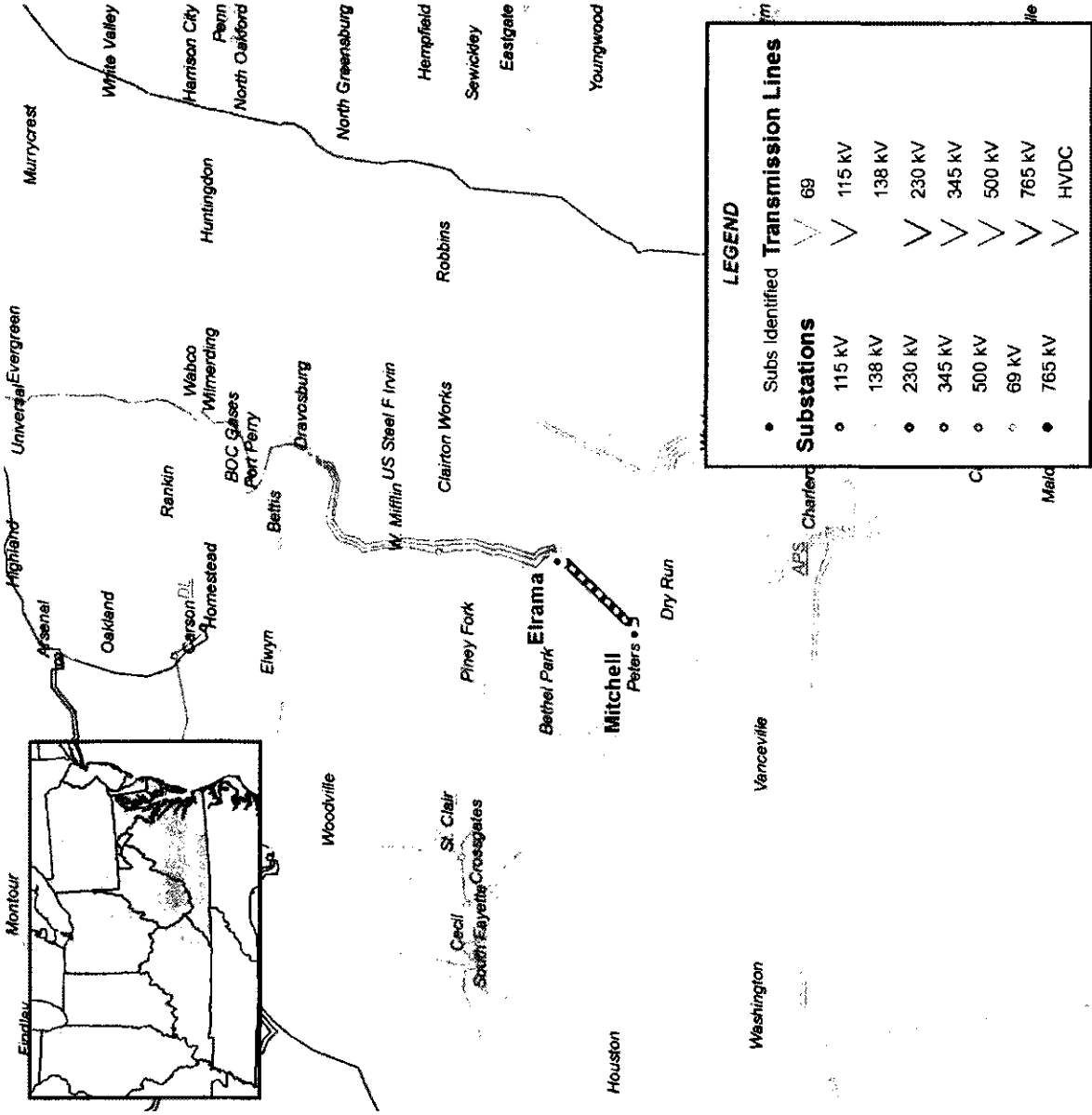
# ATSI Transmission Zone Reinforcement

- The Boardman 138 kV bus voltage magnitude is 0.916 for the N-1-1 loss of Riverbend-Salt Springs 138 + Boardman-Sammis
- Install a 50 MVAR capacitor at the Boardman 138 kV bus
- Estimated Project Cost: \$1.7M
- Projected in-service date: 6/1/2015.



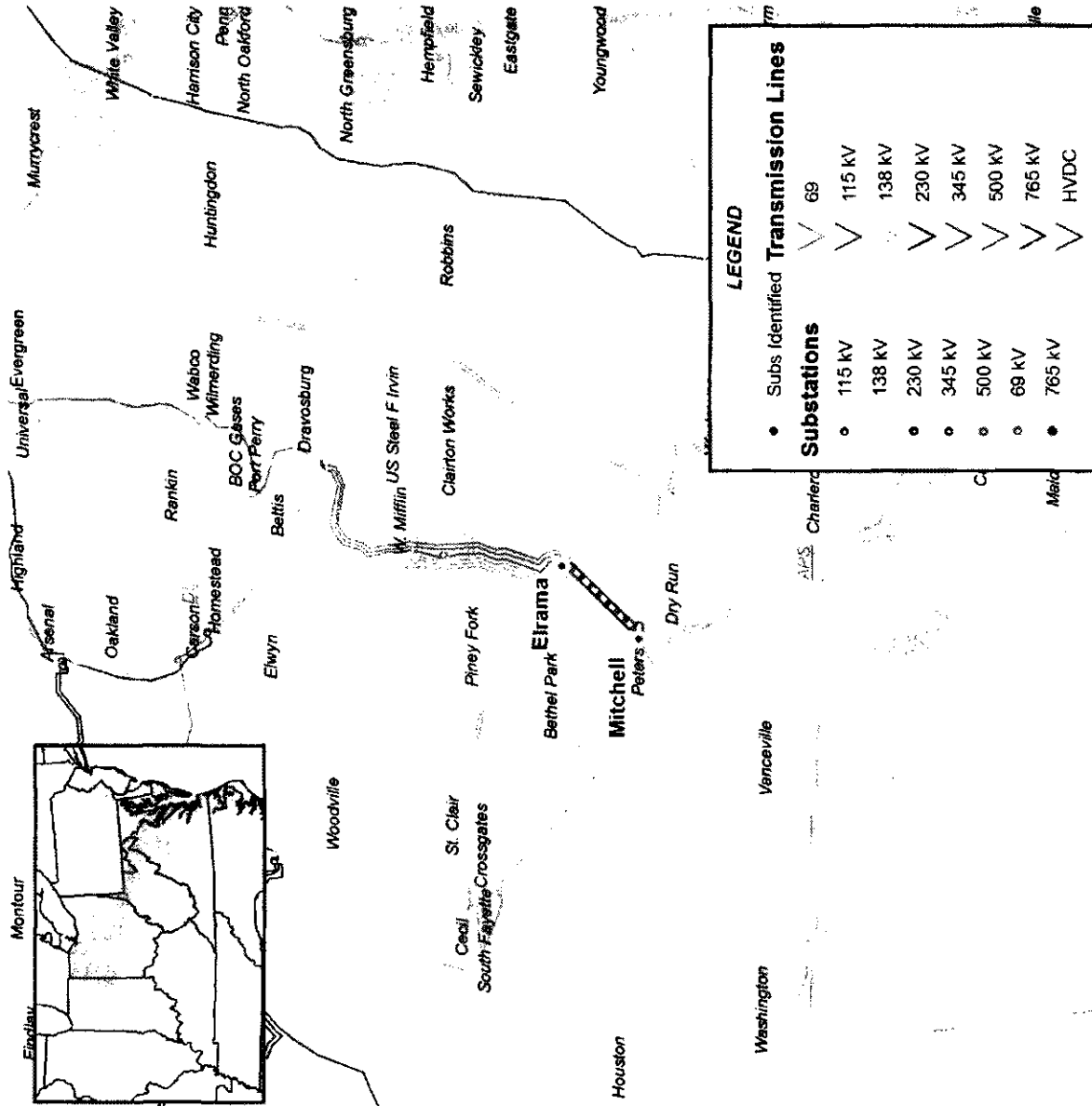


# DLCO Reinforcement



- The Elrama - Mitchell 138 kV line loads to 120.49% of its emergency rating (478 MVA) for the stuck breaker contingency loss of the Keystone - South Bend 500 kV line and the Keystone 500/230 kV transformer #4.
- Upgrade the Duquesne portion of the Elrama - Mitchell 138 kV line. (May include reconductoring the line and upgrading substation equipment.)
- Estimated Project Cost: TBD
- Projected in-service date: 4/16/2015.

## AP Transmission Zone Reinforcement

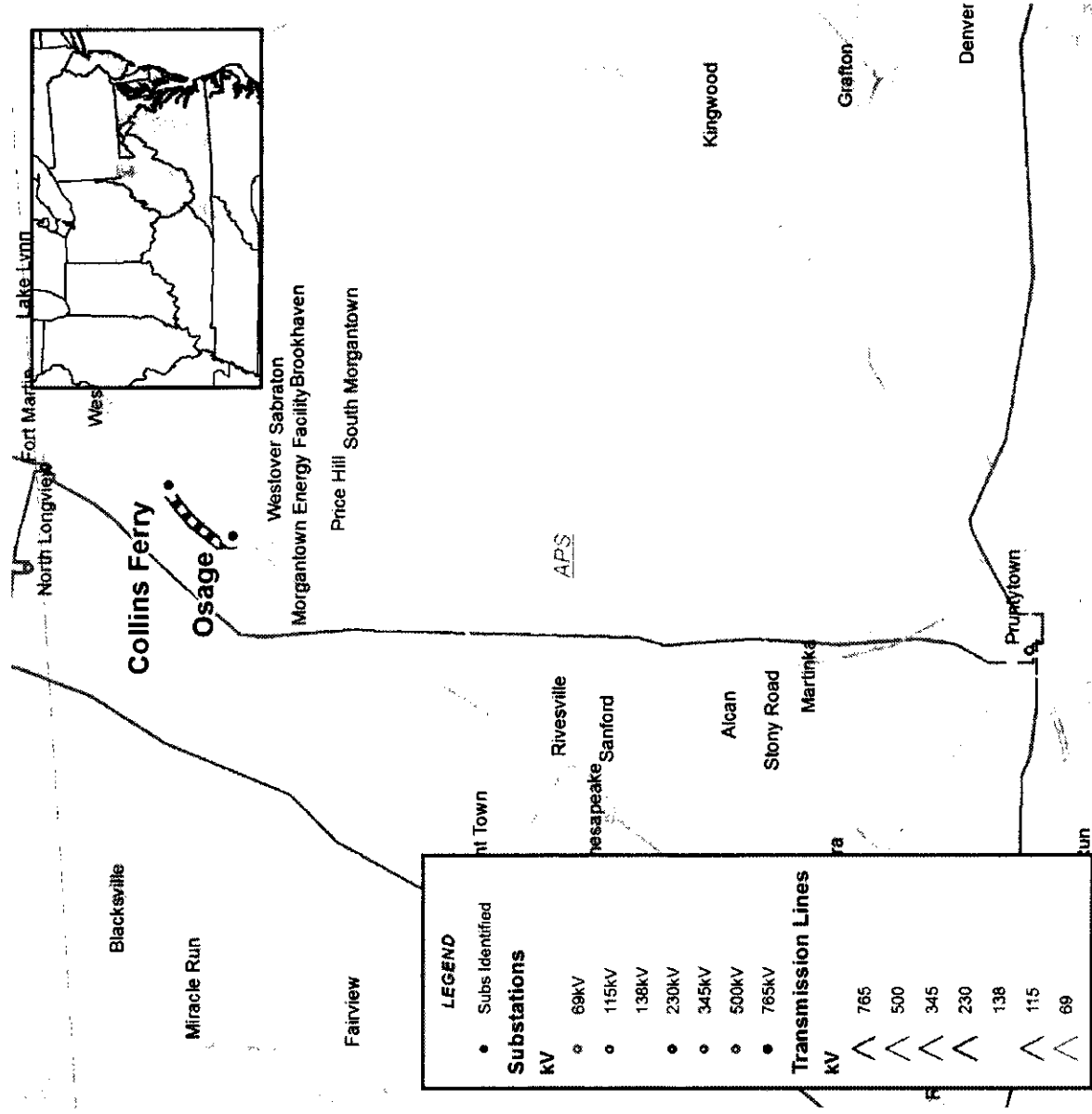


- The Elrama - Mitchell 138 kV line loads to 120.49% of its emergency rating (478 MVA) for the stuck breaker contingency loss of the Keystone – South Bend 500 kV line and the Keystone 500/230 kV transformer #4.
- Upgrade the AP portion of the Elrama – Mitchell 138 kV line by replace breaker risers on the Mitchell 138 kV bus on the Elrama terminal
- Estimated Project Cost: \$0.05M
- Projected in-service date: 6/1/2015.



# AP Transmission Zone Reinforcement

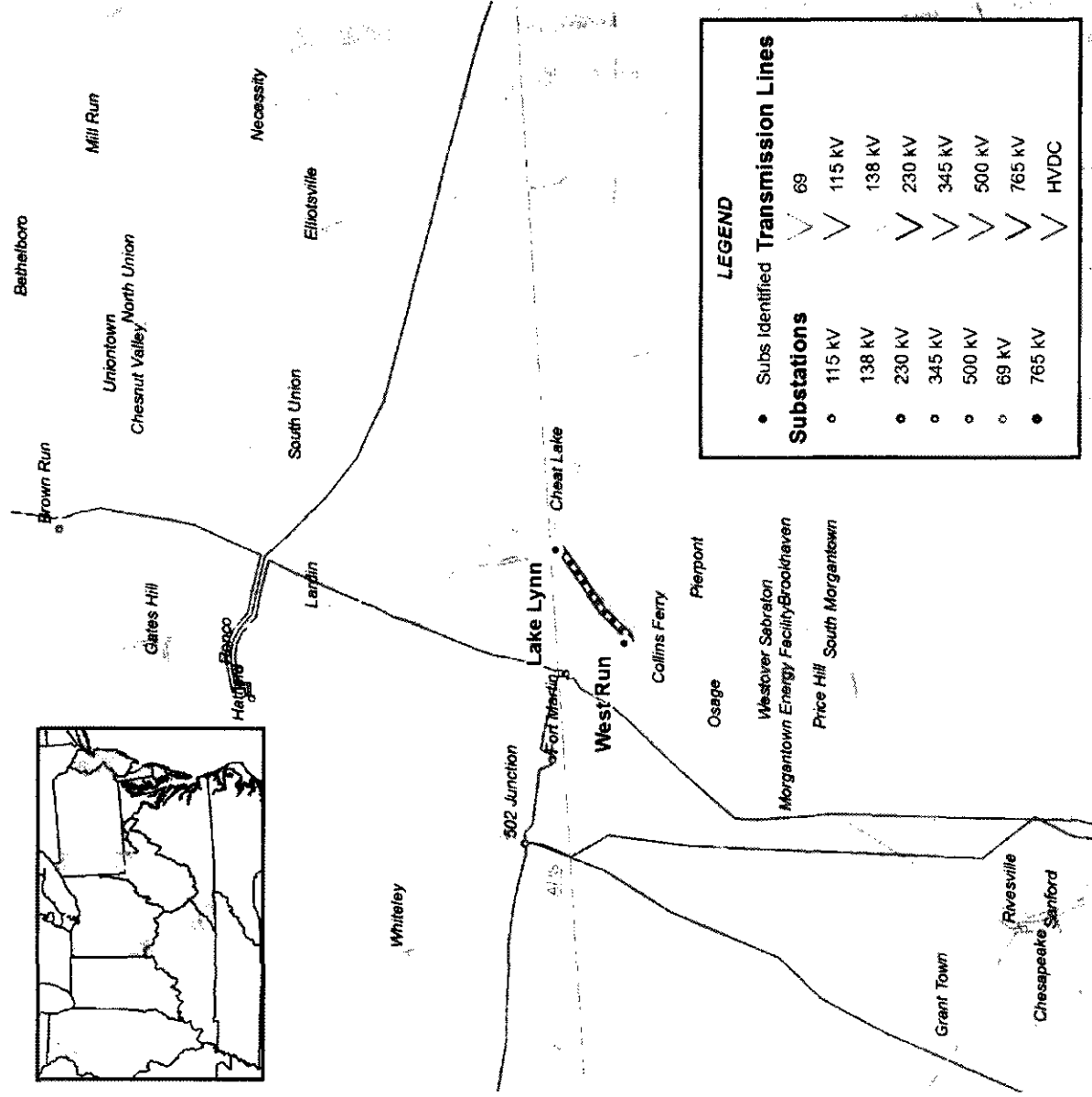
- The Osage – Collins F 138 kV line loads to 152.16% of its emergency rating (206 MVA) for the single contingency loss of the Hatfield – Ronco 500 kV line.
- Reconnector the Osage-Collins Ferry 138 kV line with 795 ACSS. Upgrade terminal equipment at Osage and Collins Ferry
- Estimated Project Cost: \$1.8M
- Projected in-service date: 6/1/2015.





# AP Transmission Zone Reinforcement

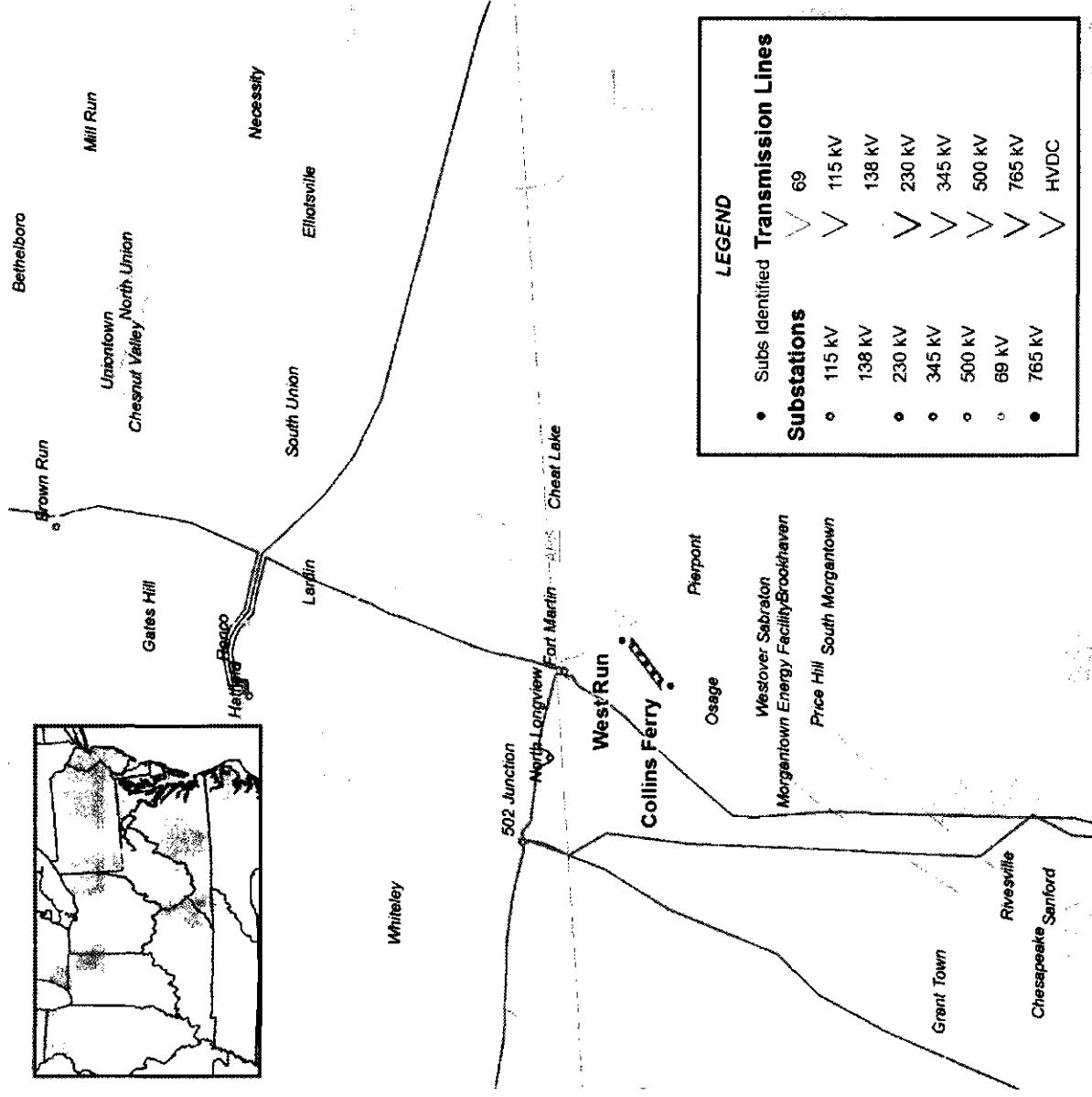
- The West Run – Lake Lynn 138 kV line loads to 104.57% of its emergency rating (213 MVA) for the single contingency loss of the Hatfield – Browns Run 500 kV line.
- Raise structures between Lake Lynn and West Run to eliminate the clearance de-rates on the West Run – Lake Lynn 138 kV line
- Estimated Project Cost: \$0.32M
- Projected in-service date: 6/1/2015.





# AP Transmission Zone Reinforcement

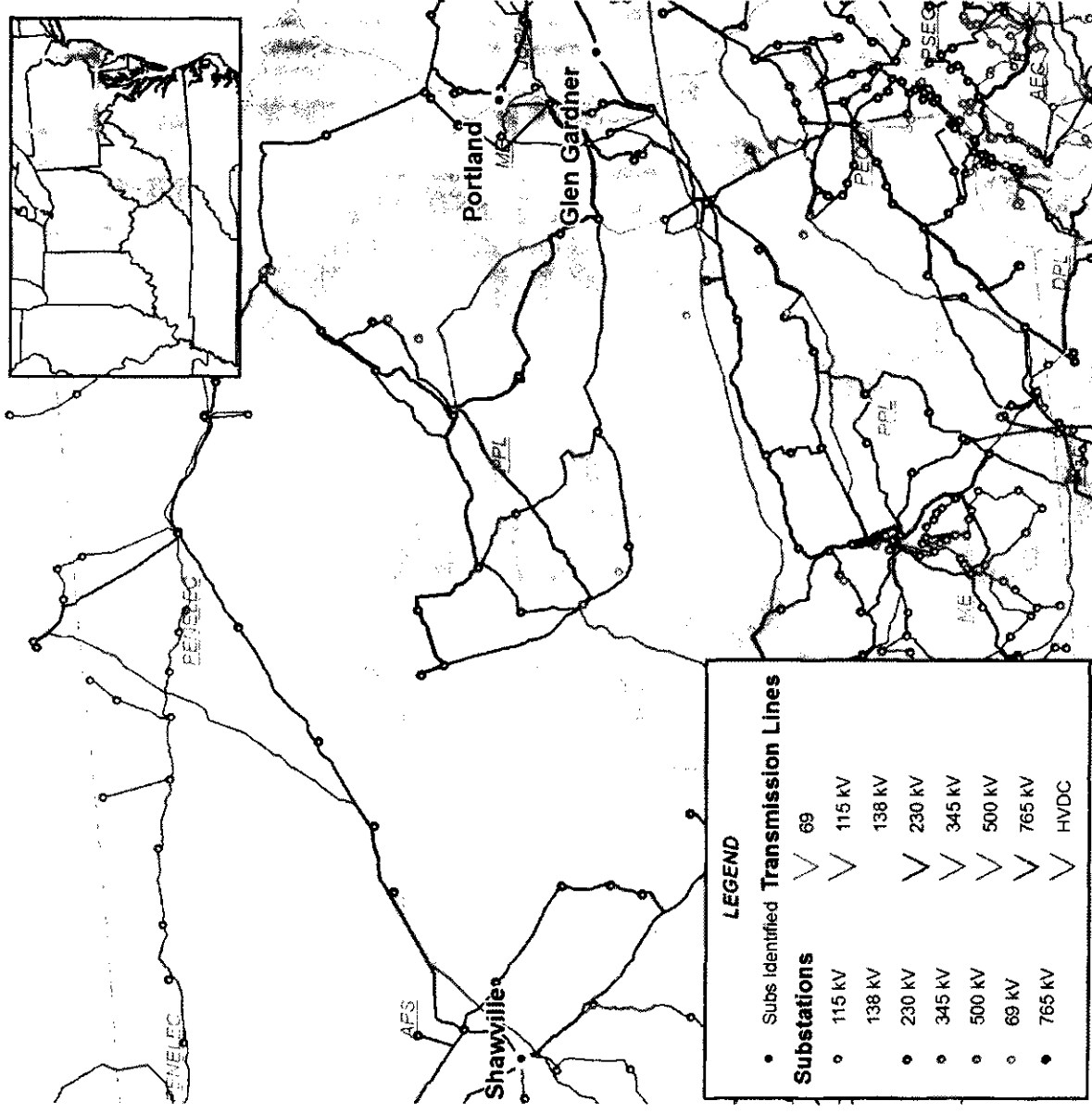
- The Collins F – West Run 138 kV line loads to 120.27% of its emergency rating (213 MVA) for the single contingency loss of the Hatfield – Browns Run 500 kV line.
- Raise structures between Collins Ferry and West Run to eliminate the clearance de-rates on the Collins Ferry - West Run 138 kV line
- Estimated Project Cost: \$0.32M
- Projected in-service date: 6/1/2015.





# GenOn Deactivations

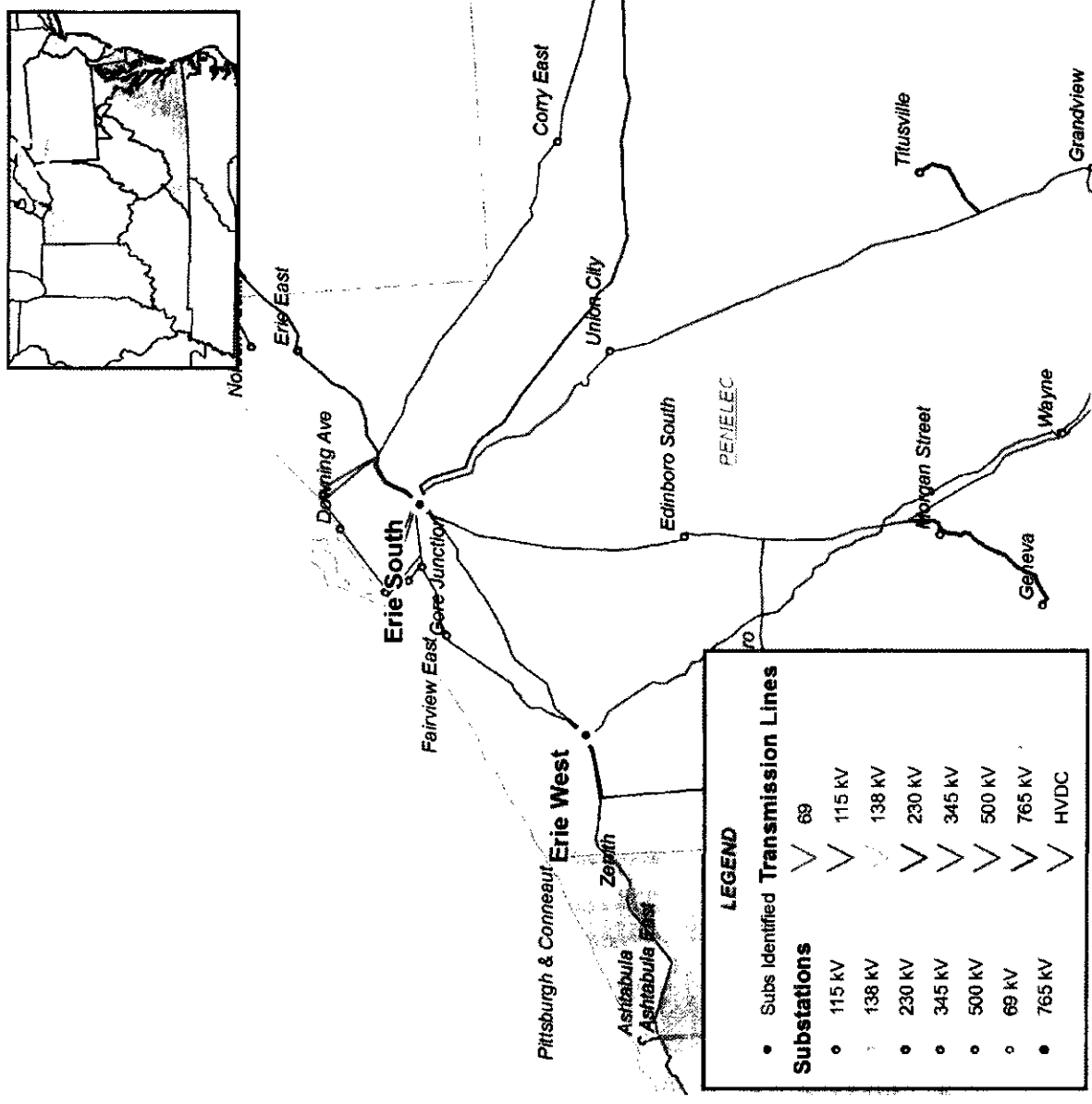
- Portland Unit 1 & 2
- Requested deactivation date: 1/7/2015
- Shawville Unit 1, 2, 3 & 4; Titus Unit 1, 2 & 3
- Requested deactivation date: 4/16/2015
- Glen Gardner CT 1-8
- Requested deactivation date: 5/1/2015





# PN Violations

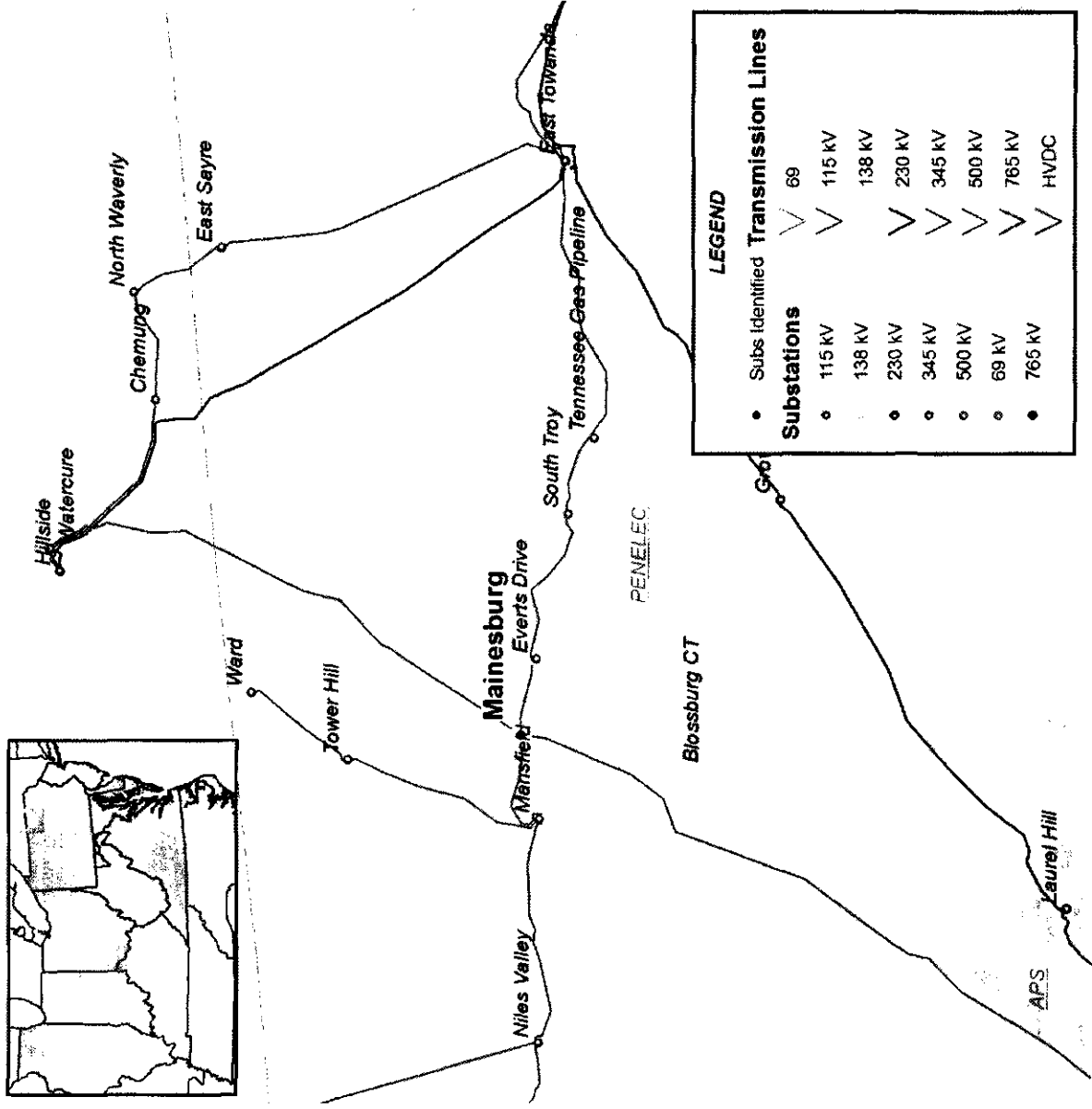
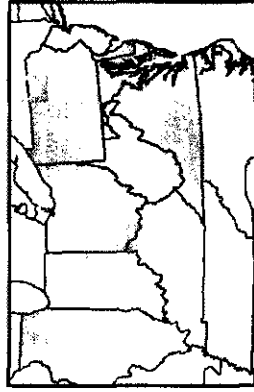
- Criteria violations
  - N-1 Voltage Magnitude
  - N-1 Voltage drop
  - N-1-1 Thermal
  - N-1-1 Voltage magnitude
  - N-1-1 Voltage drop
  - Generation Deliverability
- Load Deliverability
- Erie South & Erie West 345kV low voltage violations
- Multiple 115kV, 138kV, & 230kV low voltage and voltage drop violations
- Multiple 115kV & 230kV thermal violation
- Erie West 345/115kV transformer thermal overload
- Upgrades are described on subsequent slides





# PN Transmission Zone Reinforcement

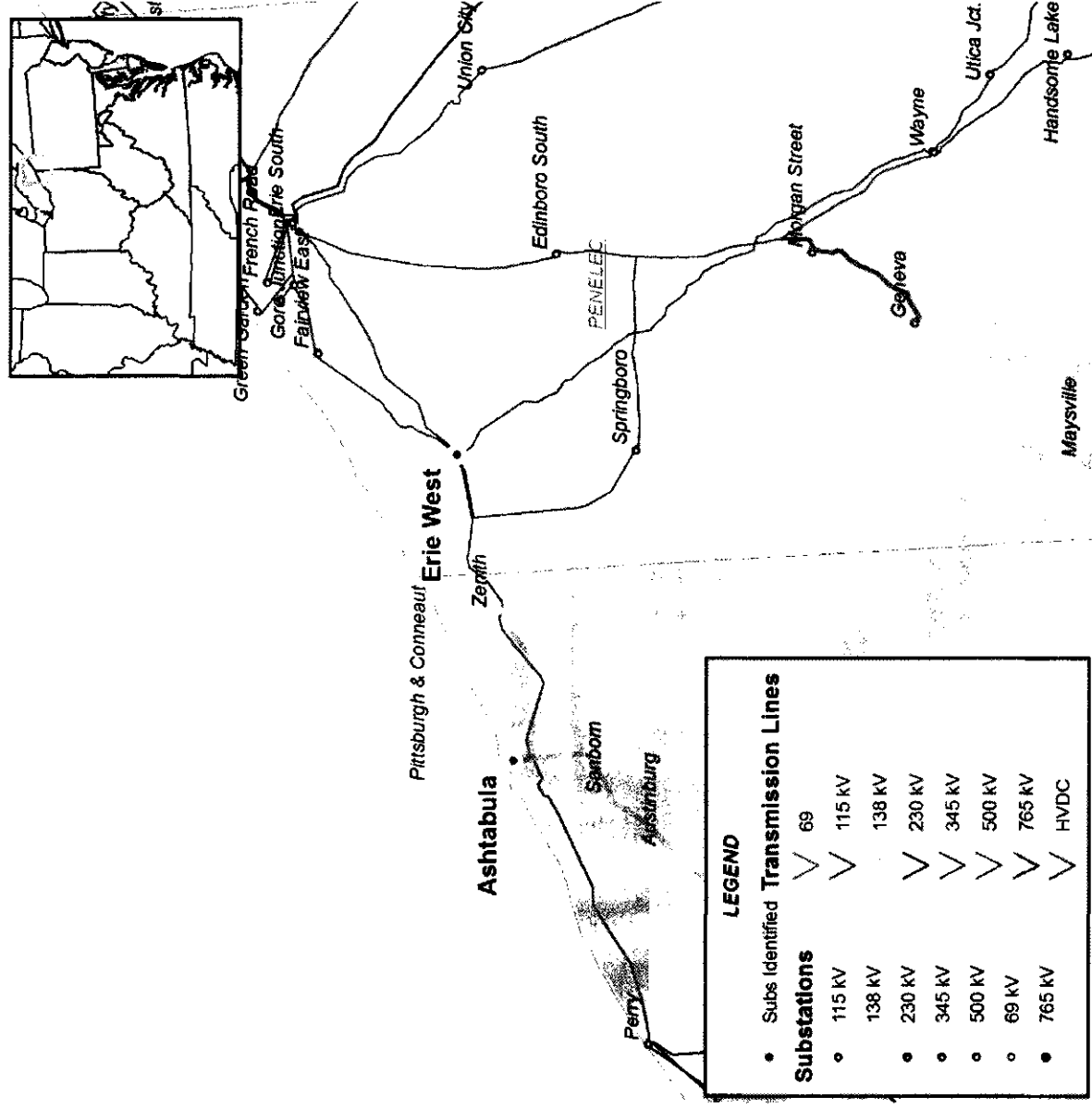
- N-1 Voltage
- Construct a new 345/115 kV substation (Mainesburg) and loop the Mansfield - Everts 115 kV (existing base line upgrade b1608 )
- Estimated Project Cost: \$18.2M
- Projected in-service date: 6/1/2014





## PN Transmission Zone Reinforcement

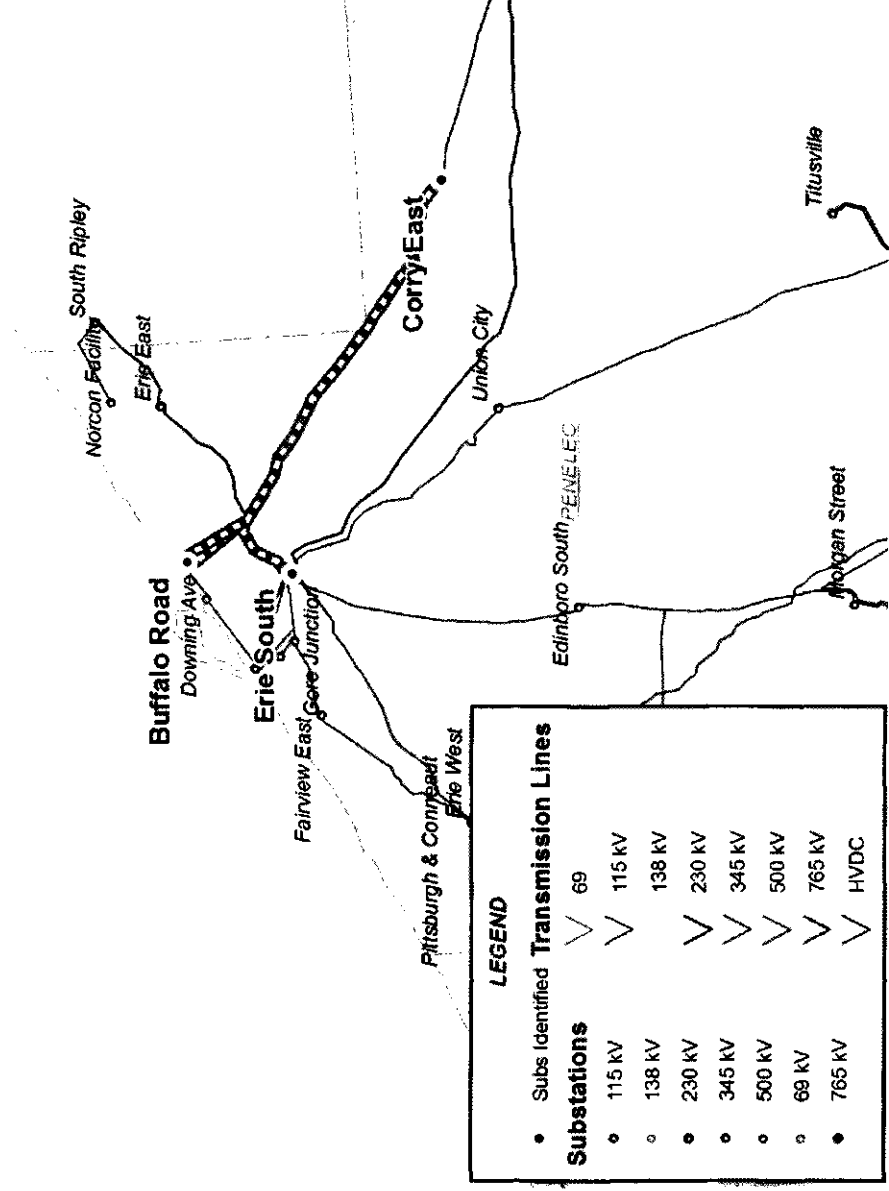
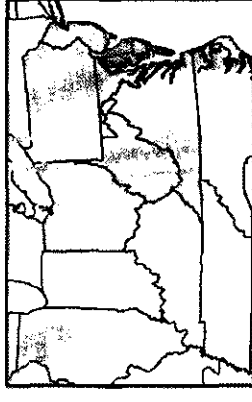
- N-1 Voltage, Generator Deliverability
- Re-configure the Erie West 345 kV substation, add a new circuit breaker and relocate the Ashtabula line exit (existing base line upgrade b1373)
- Estimated Project Cost: \$.955M
- Projected in-service date: 6/1/2012





# PN Transmission Zone Reinforcement

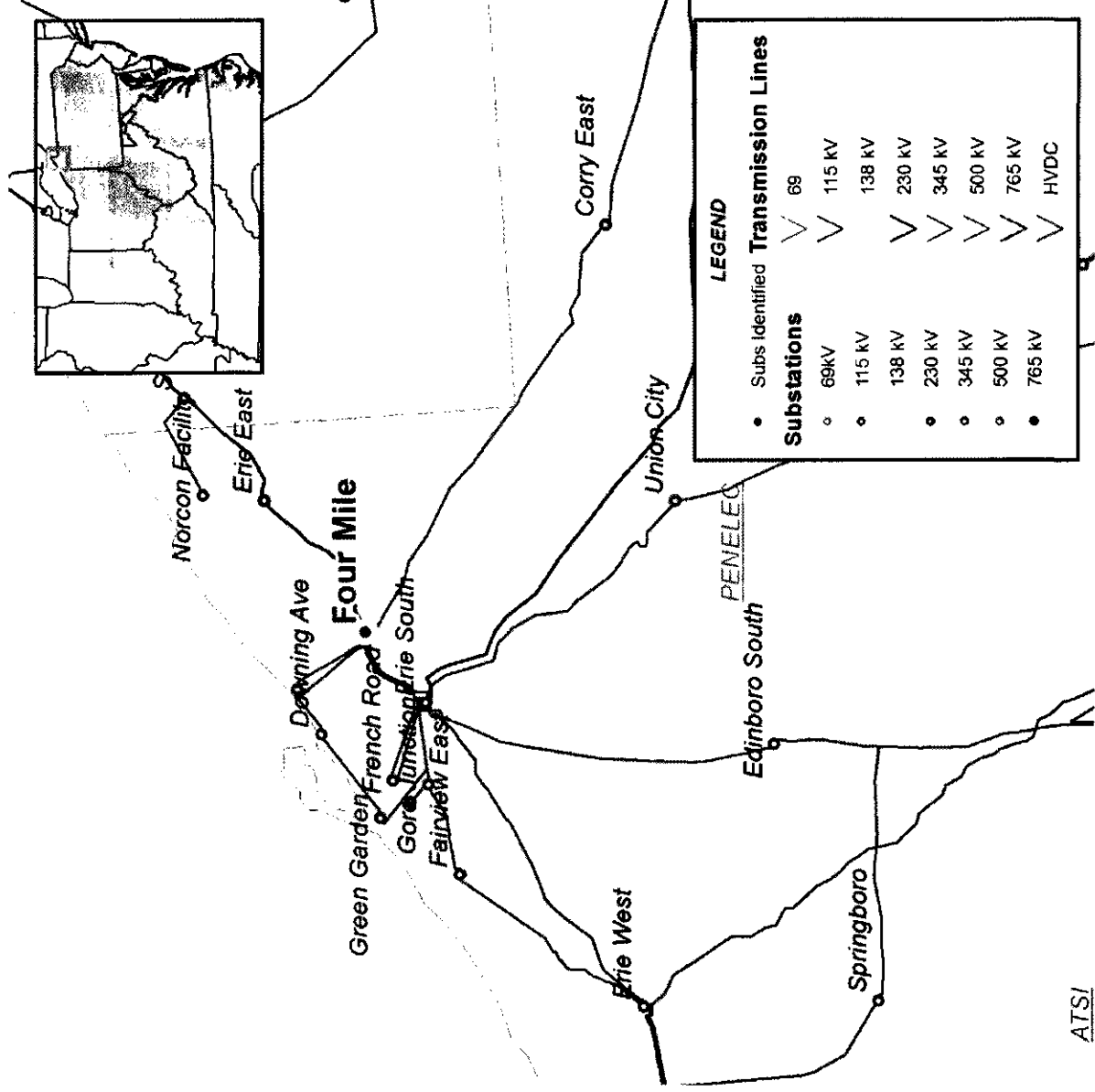
- Previously identified for Armstrong 1 & 2; Ashtabula 5; Bayshore 2-4; Eastlake 1-5; Lake Shore 18; R Paul Smith 3 & 4
- N-1 Voltage
- Construct Four Mile Junction 230/115 kV substation. Loop the Erie South - Erie East 230 kV line, Buffalo Road - Corry East and Buffalo Road - Erie South 115 kV lines (existing base line upgrade b1609)
- Estimated Project Cost: \$17.9M
- Projected in-service date: 6/1/2014





## PN Transmission Zone Reinforcement

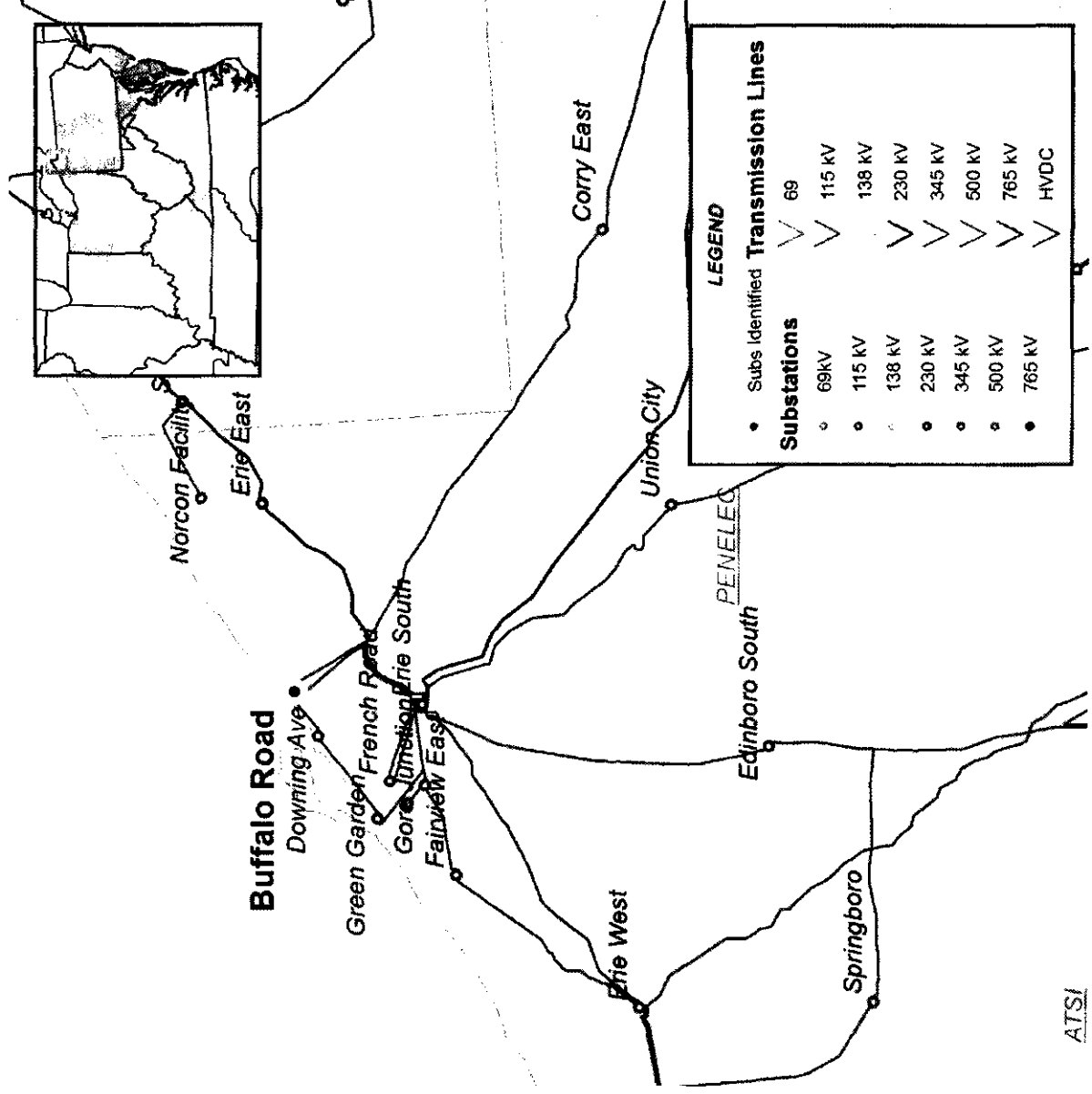
- N-1 Voltage
- Install a 75 MVAR cap bank on the Four Mile Junction 230 kV bus (existing base line upgrade b1769)
- Estimated Project Cost: \$1.4M
- Projected in-service date: 6/1/2014





# PN Transmission Zone Reinforcement

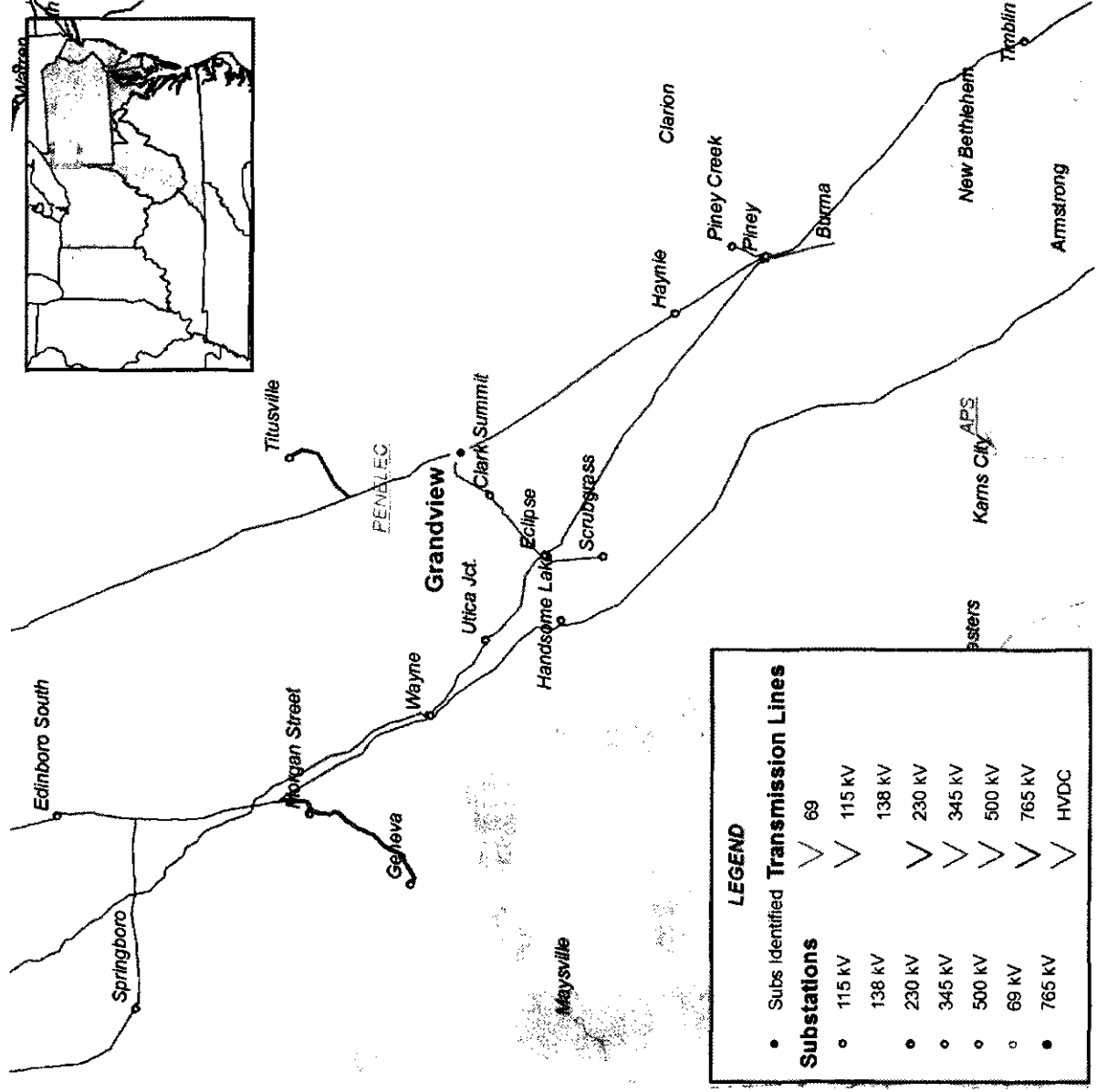
- N-1 Voltage
- Install a 50 MVAR cap bank on the Buffalo Road 115 kV bus (existing base line upgrade b1770)
- Estimated Project Cost: \$1.1M
- Projected in-service date: 6/1/2015





# PN Transmission Zone Reinforcement

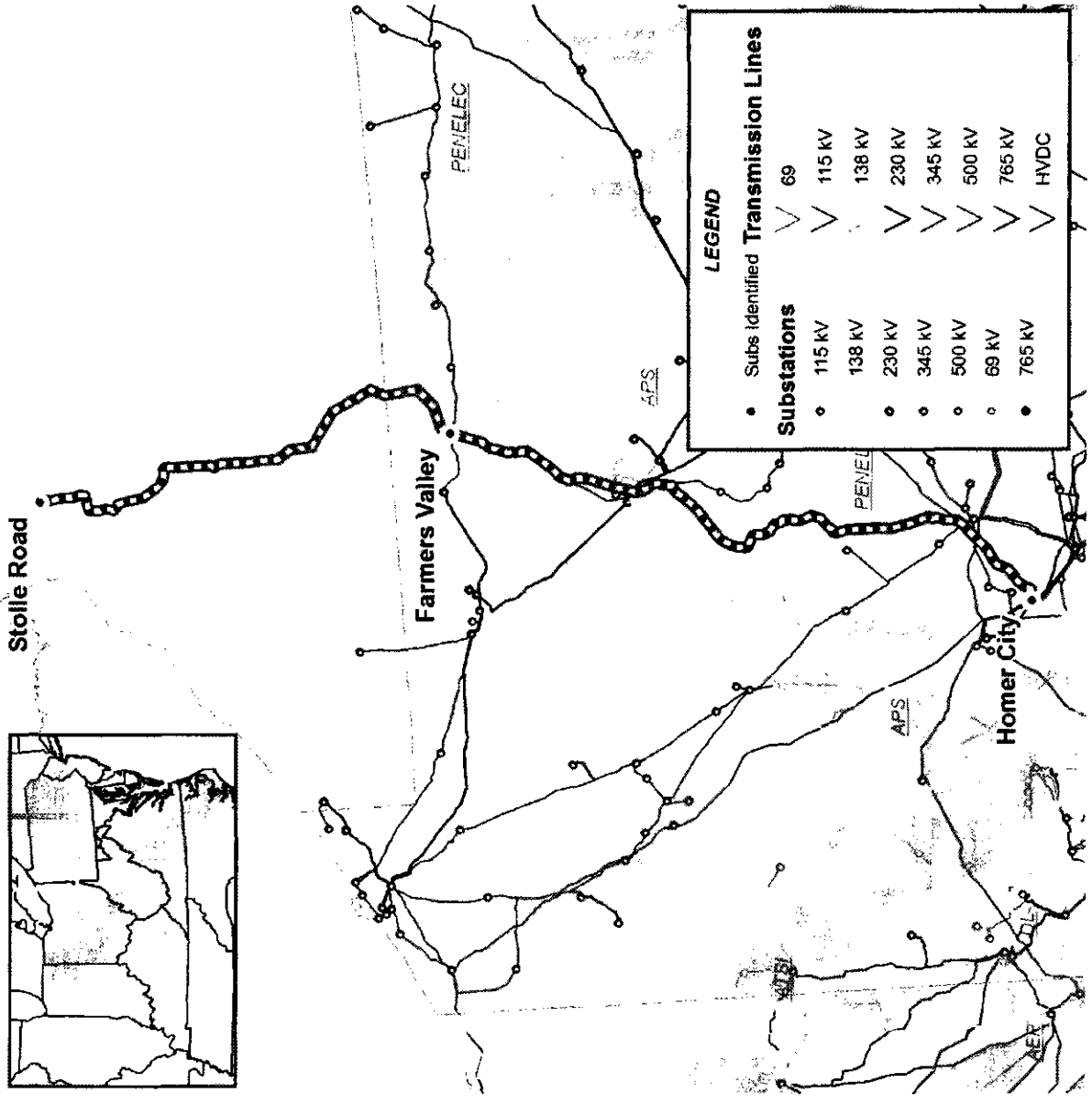
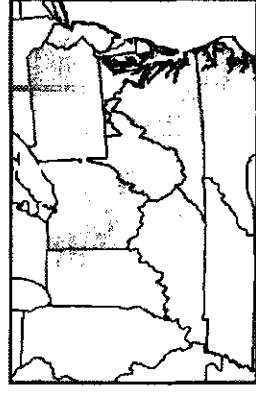
- Low voltage of 0.8829 p.u. is observed on Grandview 115kV bus for N-1 test for the stuck breaker on Eclipse 115kV substation.
- Install a 25 MVAR 115 kV Capacitor at Grandview
- Estimated Project Cost: \$0.9M
- Projected in-service date: 6/1/2015

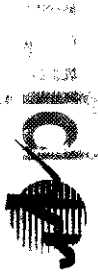




# PN Transmission Zone Reinforcement

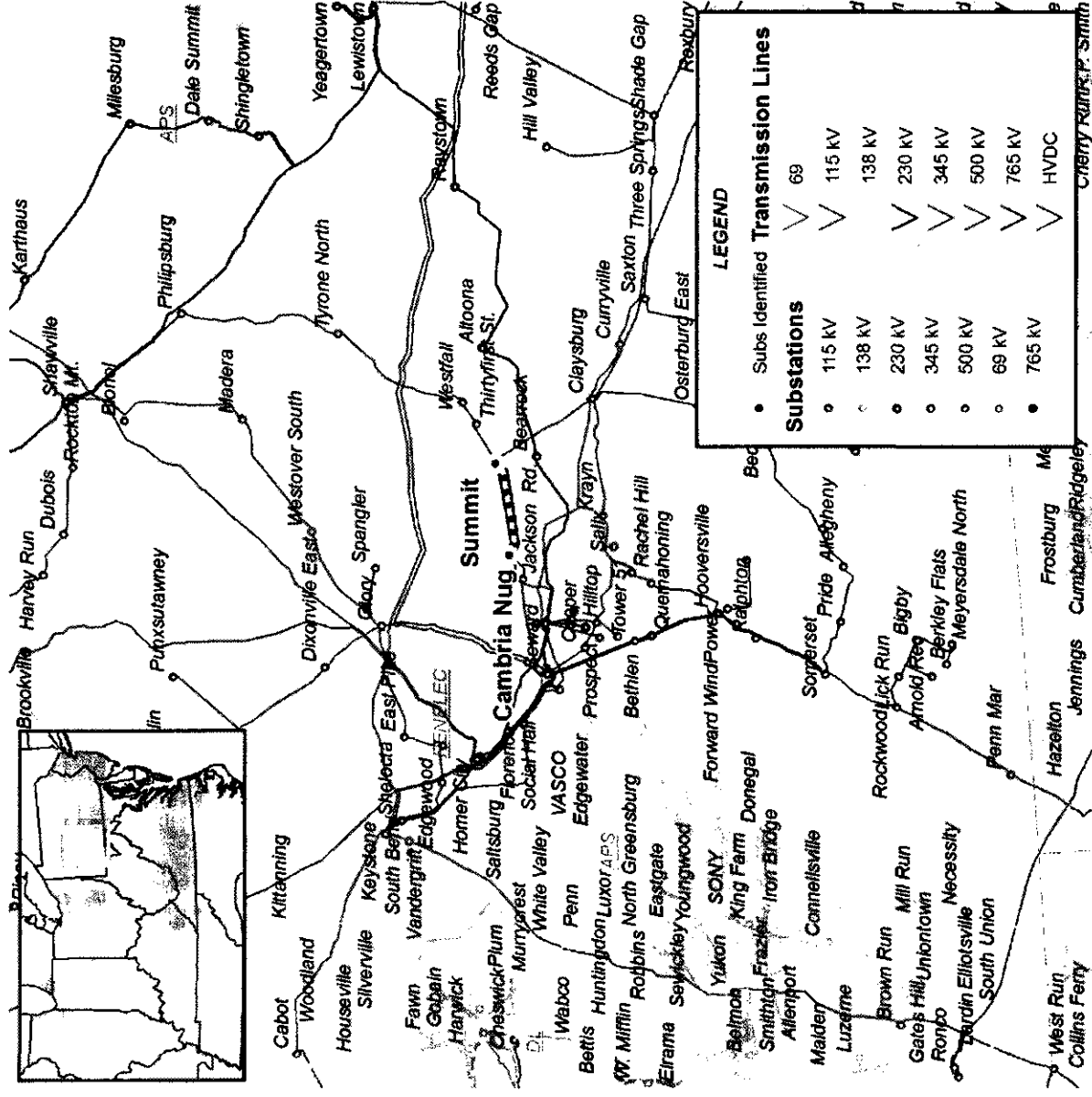
- Voltage of 0.8075 p.u. is observed on Farmers Valley 115kV bus for a stuck breaker at Glade 230kV sub.
- Towanda – Towanda5 115kV line loads to 150.32% of its rating of 156MVA for the loss of Glade – Lewis Run 230kV + Lewis Run #2&4 transformers followed by the loss of Farmers Valley – Ridgeway 115kV.
- Multiple other voltage and thermal violations.
- Construct Farmers Valley 345/230 kV and 230/115 kV substation. Loop the Homer City-Stolle Road 345 kV line into Farmers Valley
- Estimated Project Cost: \$29.5M
- Projected in-service date: 6/1/2015





# PN Transmission Zone Reinforcement

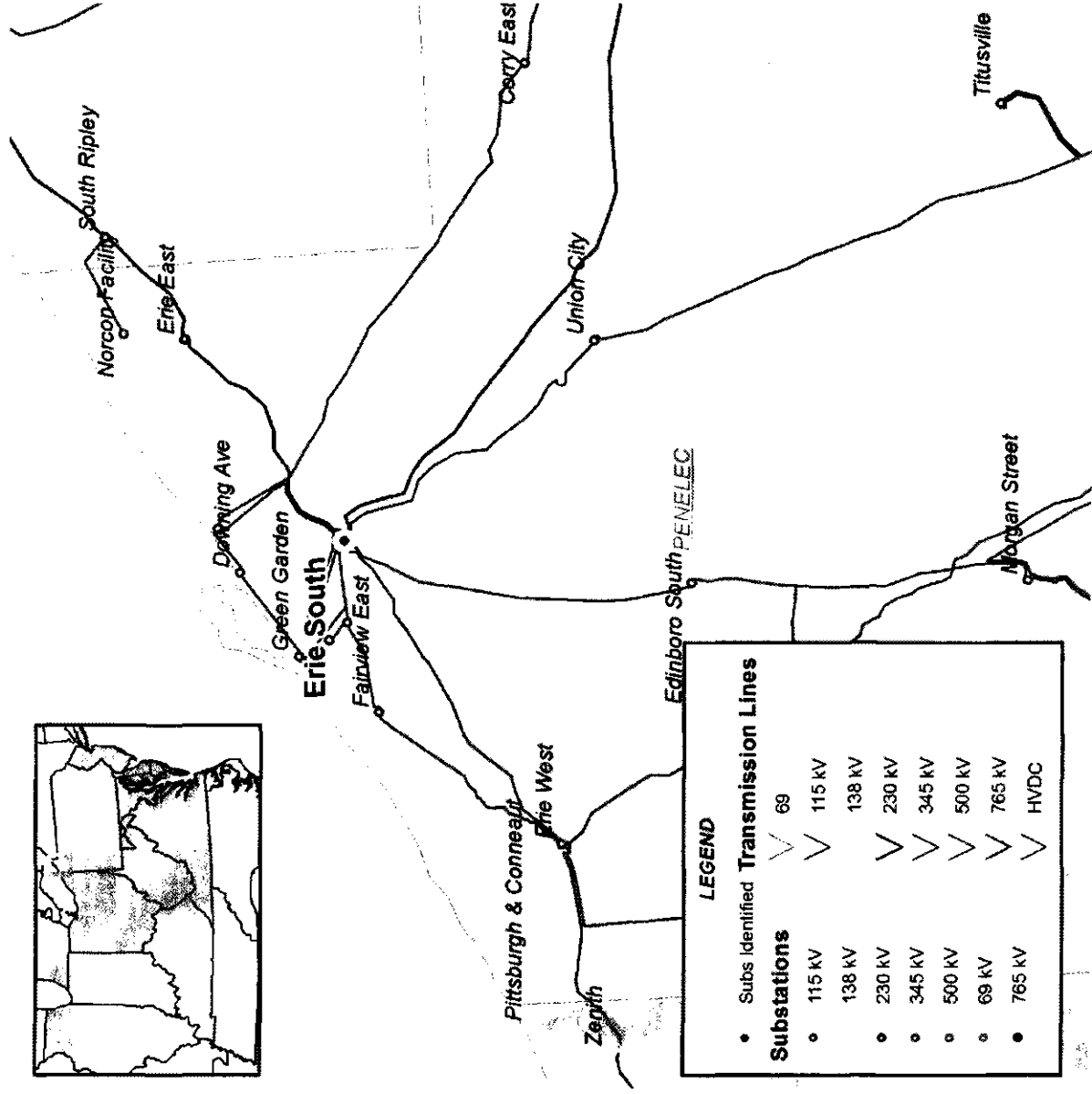
- Cambria Slope – Summit 115kV line loads to 109.13% of its emergency rating of 251MVA for the stuck breaker at Bear Rock 230kV substation
- Reconducter Cambria Slope-Summit 115kV with 795 ACSS Conductor
- Estimated Project Cost: \$4.8M
- Projected in-service date: 6/1/2015





## PN Transmission Zone Reinforcement

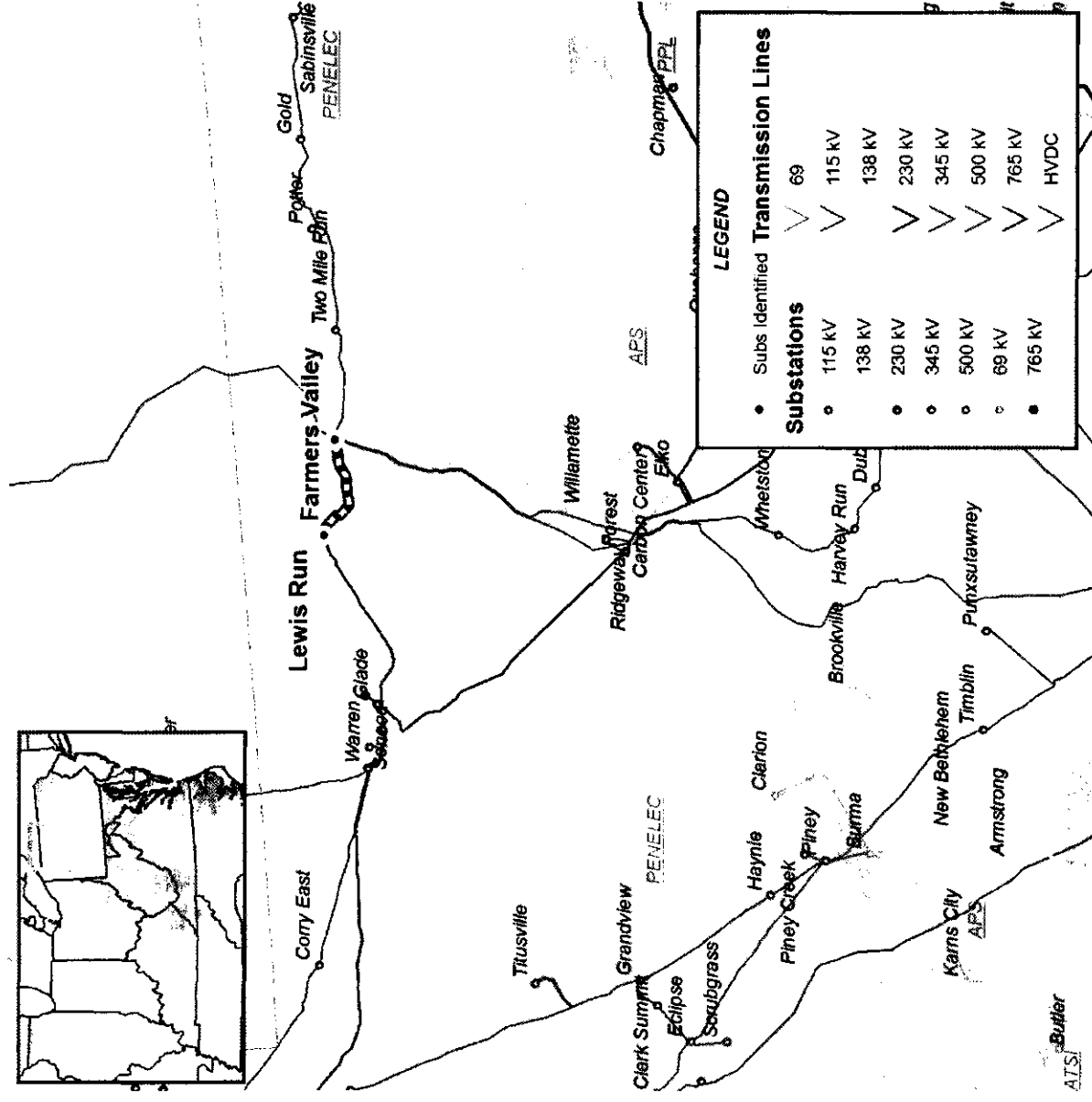
- Erie West 345/115kV transformer #3 loads to 114.56% for the stuck breaker at Erie West 345kV substation
- Relocate the Erie South 345 kV line terminal
- Estimated Project Cost: \$13M
- Projected in-service date: 6/1/2015





## PN Transmission Zone Reinforcement

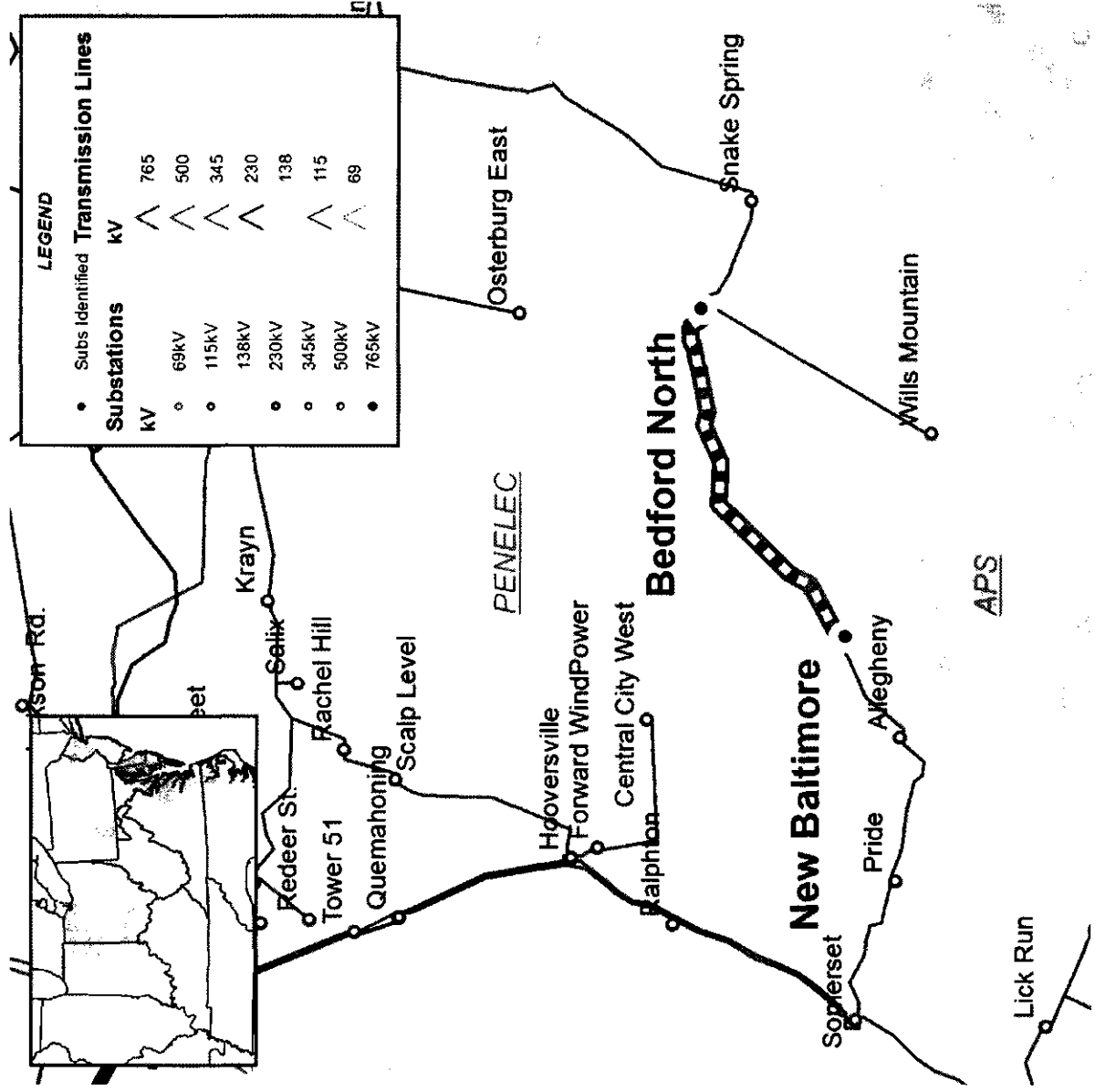
- Lewis Run – Farmers Valley 115kV loads to 134.51% of its emergency rating of 149MVA for the stuck breaker at Forest 230kV substation.
- Convert Lewis Run-Farmers Valley to 230 kV using 1033.5 ACSR conductor. Project to be completed in conjunction with new Farmers Valley 345/230 kV transformation
- Estimated Project Cost: \$46.8M
- Projected in-service date: 6/1/2015





# PN Transmission Zone Reinforcement

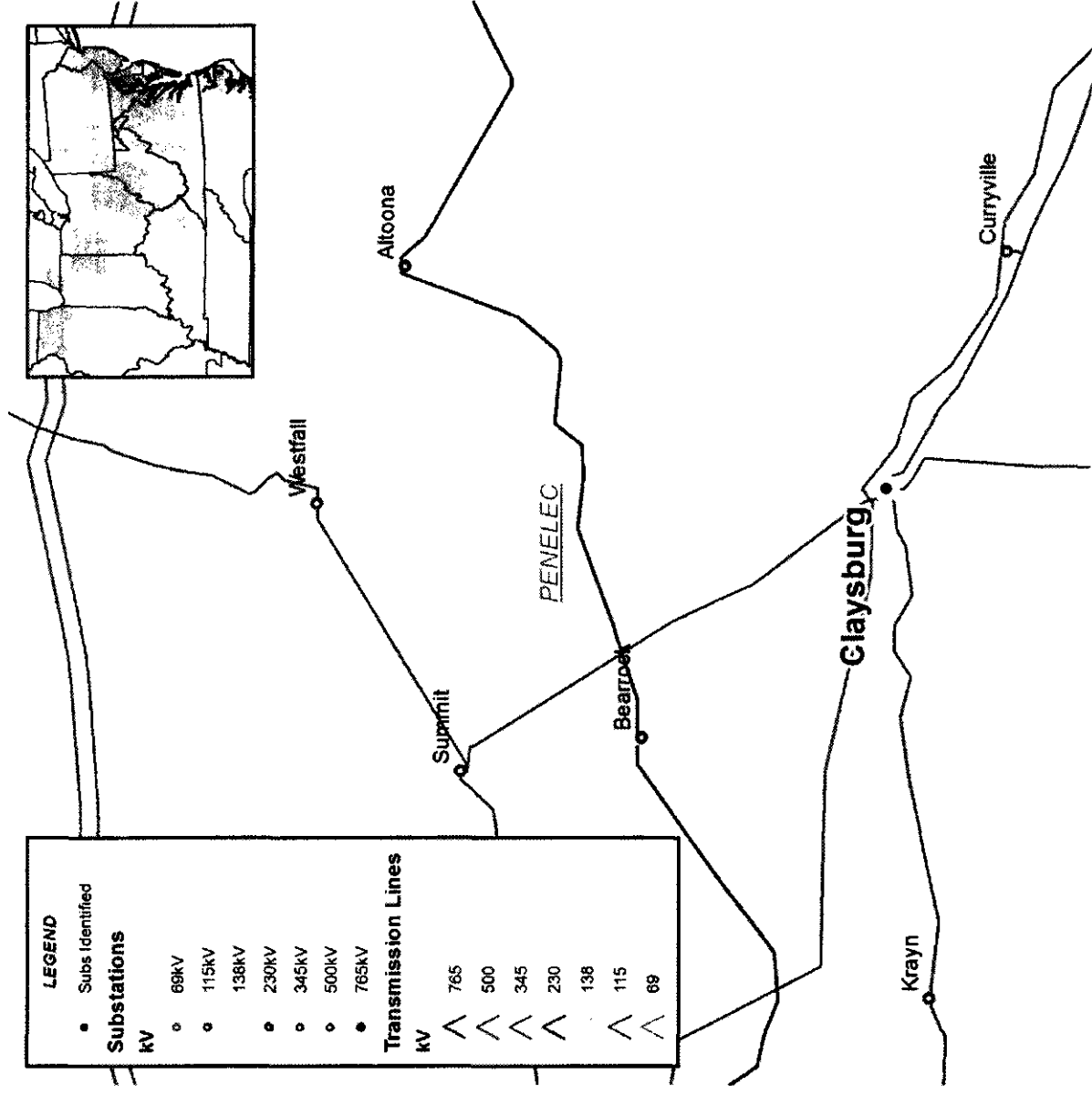
- Generator Deliverability
- Reconnector the New Baltimore - Bedford North 115 kV (existing base line b1607 )
- Estimated Project Cost: \$8.3M
- Projected in-service date: 6/1/2015





## PN Transmission Zone Reinforcement

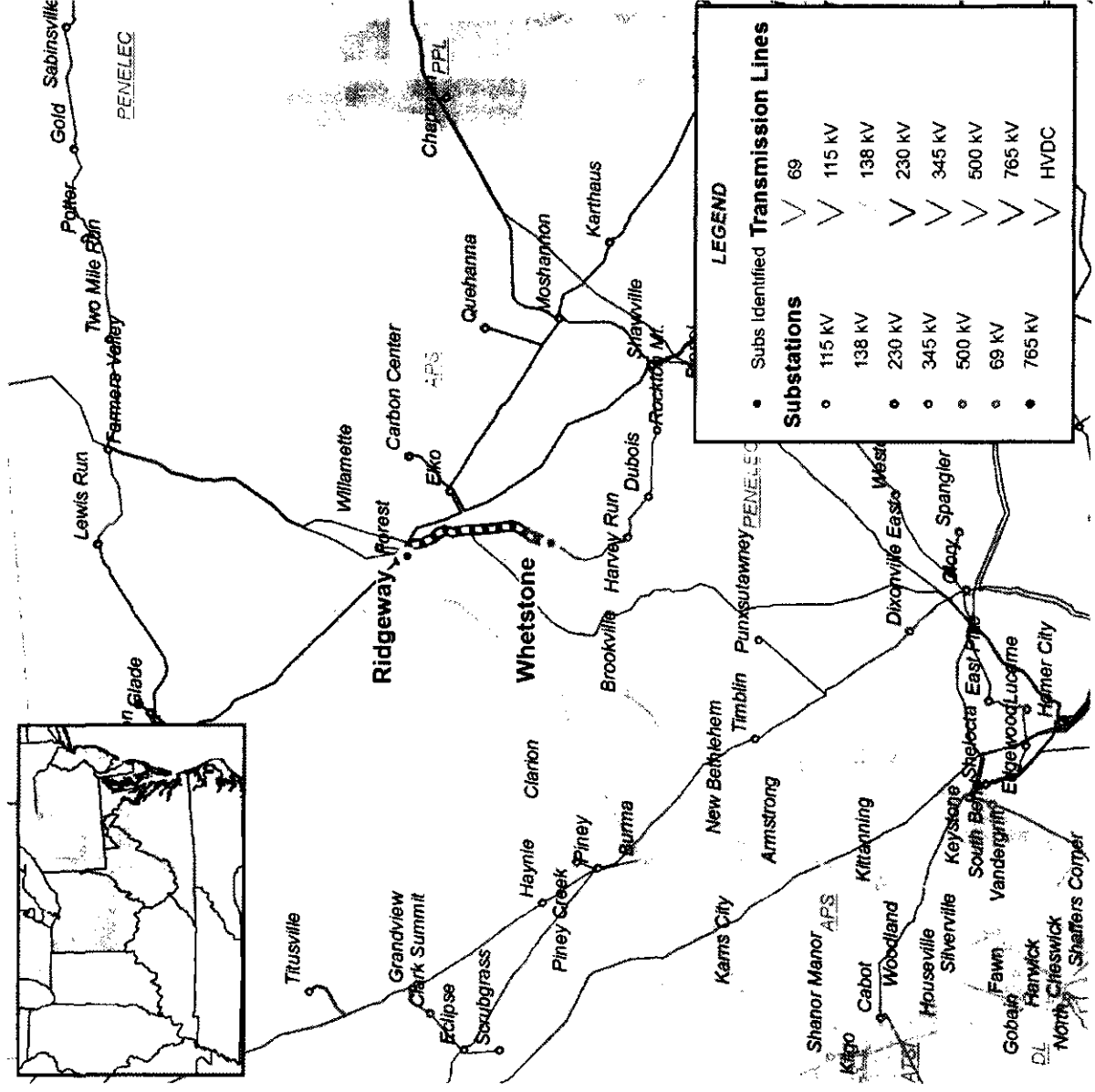
- O18 – Claysburg 115kV line loads to 106.42% of its emergency rating of 216 MVA for stuck breaker at Cambria Slope 115kV substation.
- Change CT Ratio at Claysburg
- Estimated Project Cost: \$0.002M
- Projected in-service date: 6/1/2015





## PN Transmission Zone Reinforcement

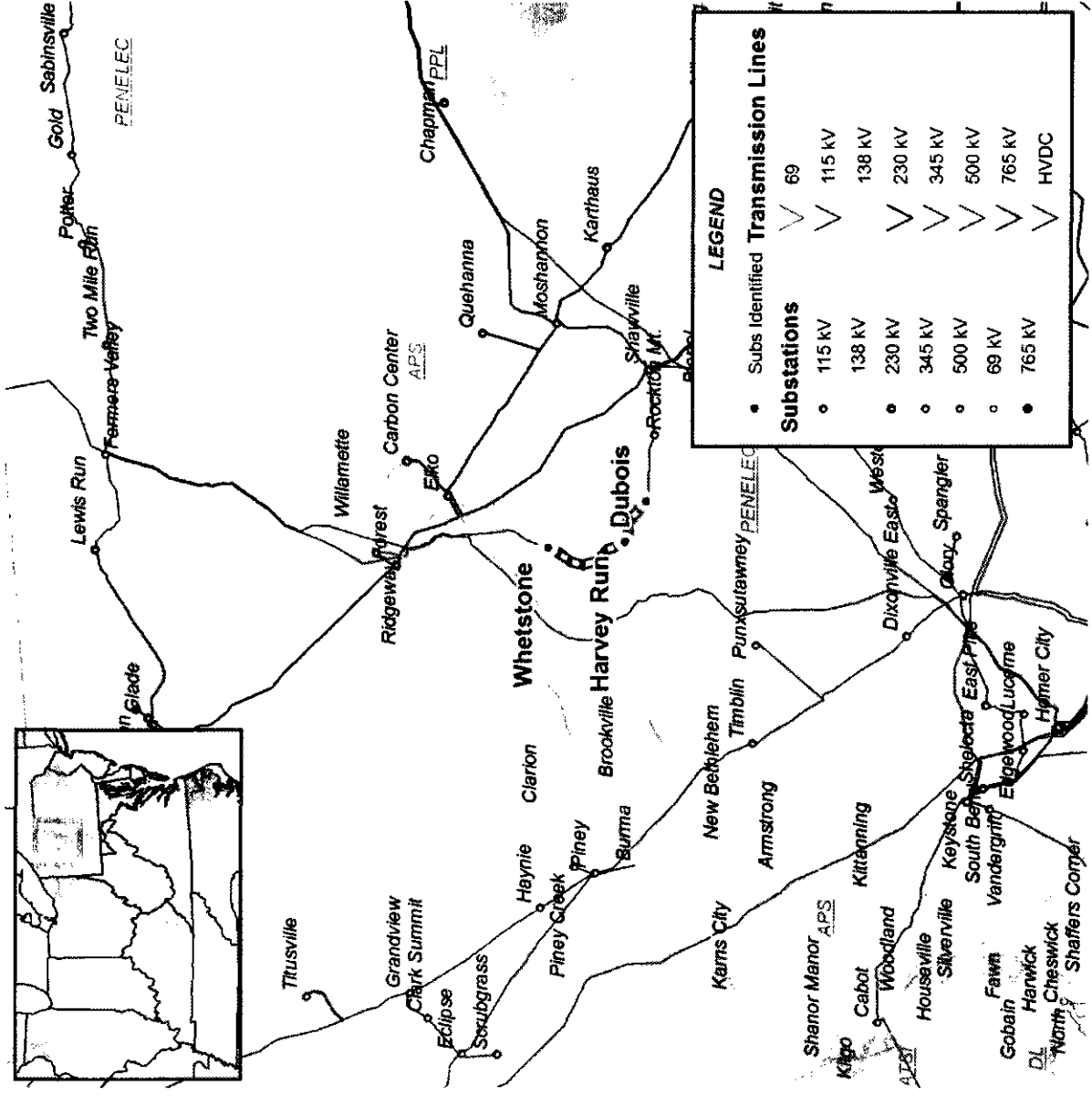
- Ridgeway – Whetstone 115kV line loads to 118.73% of its emergency rating of 157MVA for stuck breaker at Elco 230kV substation
- Replace 600 Amp Disconnect Switches on Ridgeway-Whetstone 115 kV line with 1200 Amp Disconnects. Reconnector Ridgeway and Whetstone 115 kV Bus. Replace Wave Trap at Ridgeway. Change CT Ratio at Ridgeway
- Estimated Project Cost: \$0.5M
- Projected in-service date: 6/1/2015





## PN Transmission Zone Reinforcement

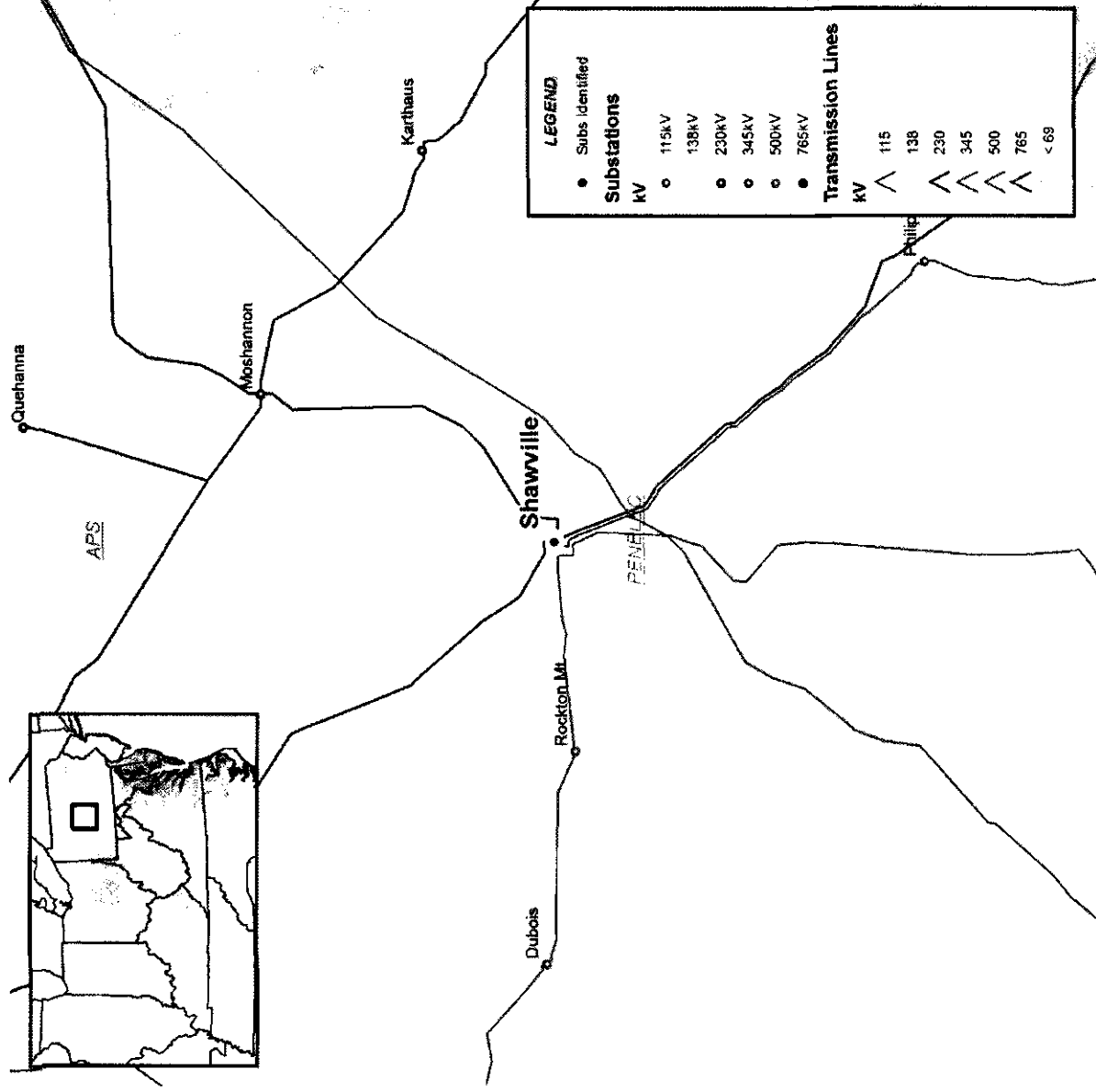
- Whetstone – HARVY.RU 115kV line loads to 107.41% of its emergency rating of 157MVA for stuck breaker at Elco 230kV substation
- Replace 600 Amp Disconnect Switches on Dubois-Harvey Run-Whetstone 115 kV line with 1200 Amp Disconnects
- Estimated Project Cost: \$0.2M
- Projected in-service date: 6/1/2015





## PN Transmission Zone Reinforcement

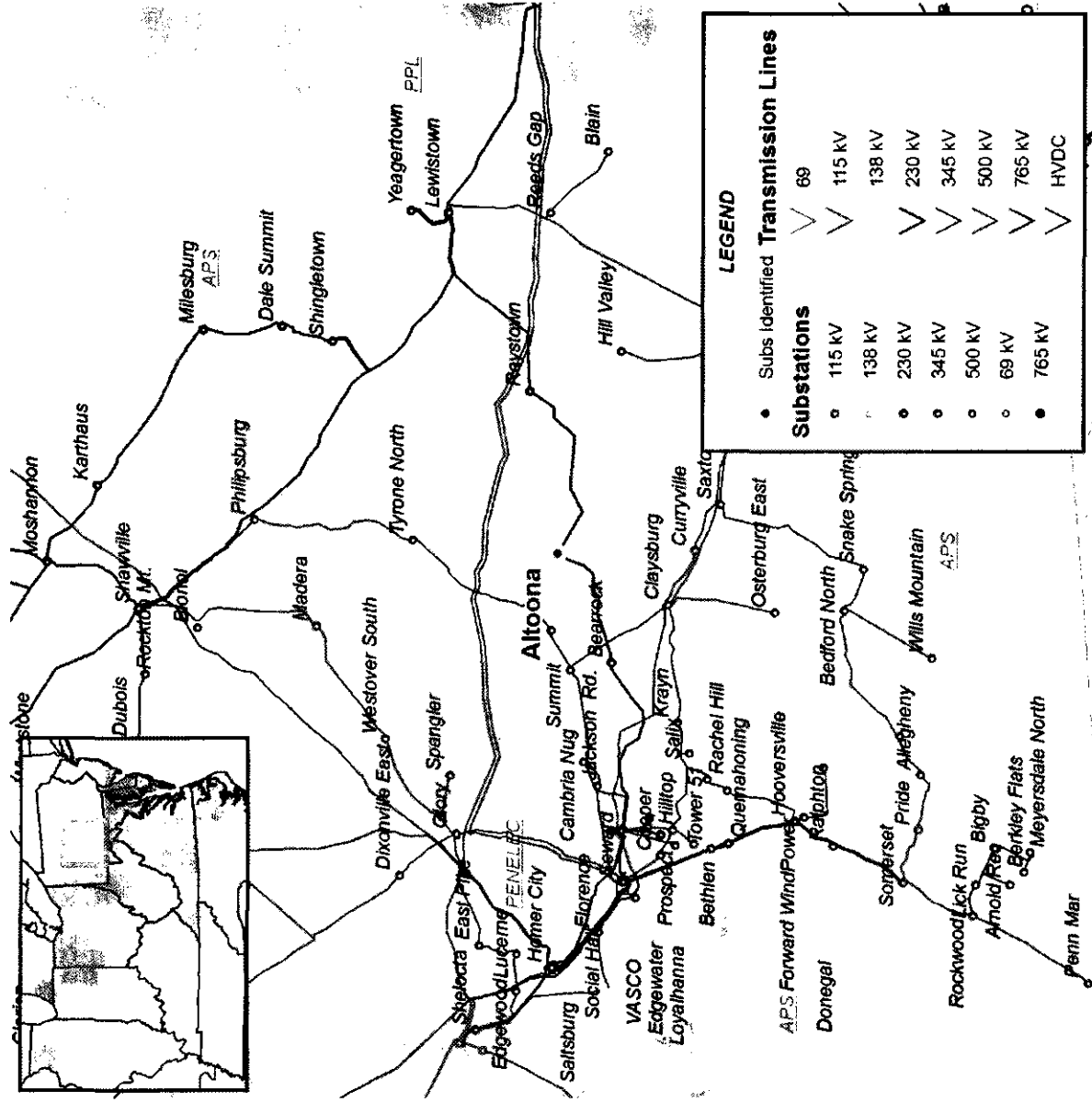
- Low voltage of 0.8871 p.u. is observed on Shawville 115kV bus for the loss of Ridgeway – Whetstone 115kV+Whetstone XF#1 followed by the loss of Elko – Forest 230kV
- Install a 75 MVAR 115 kV Capacitor at Shawville
- Estimated Project Cost: \$1.5M
- Projected in-service date: 6/1/2015





# PN Transmission Zone Reinforcement

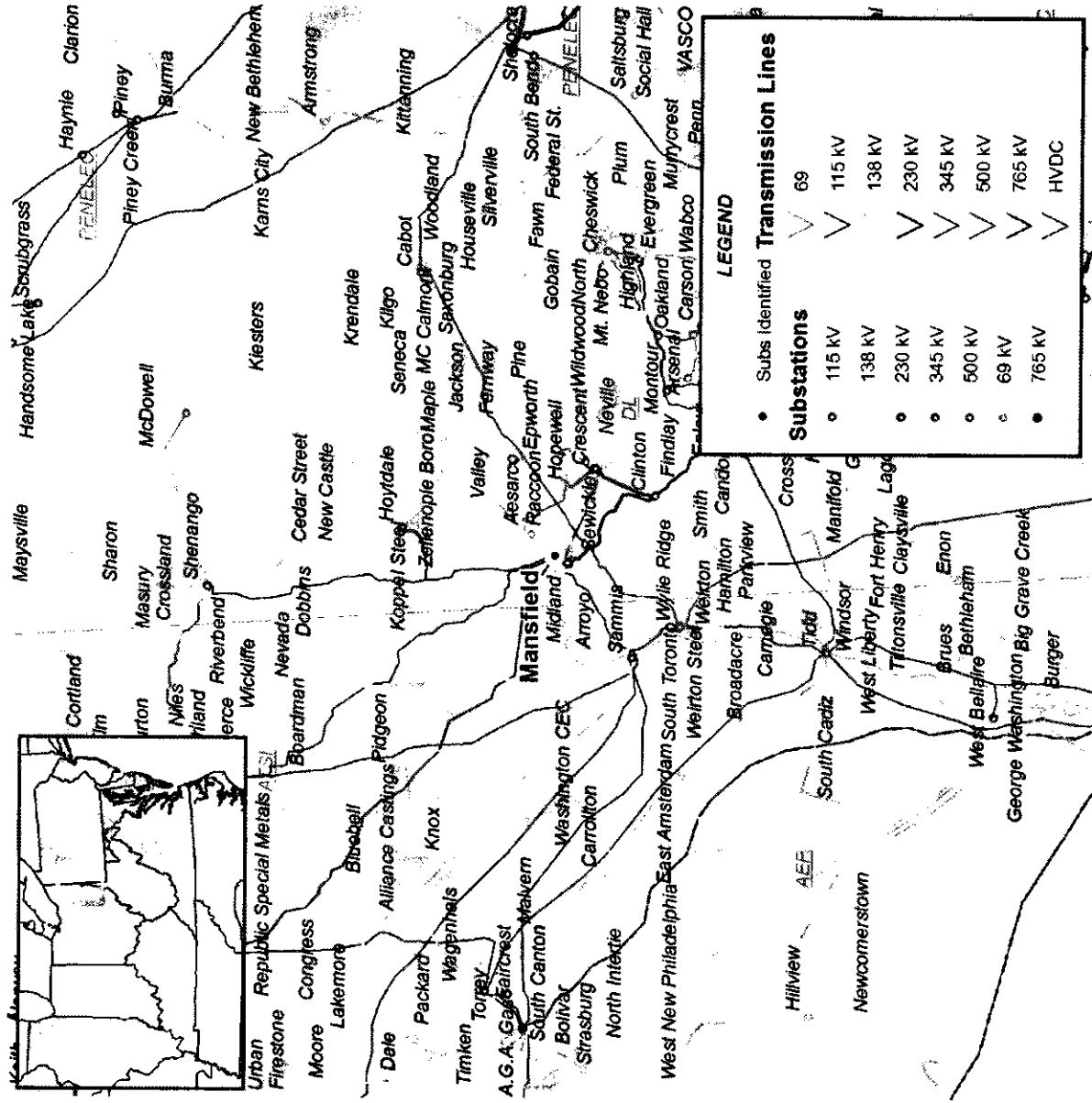
- Install a 250 MVAR SVC at Altoona 230 kV (existing base line upgrade b1801)
- Estimated Project Cost: \$43M
- Projected in-service date: 6/1/2015 (no advancement needed)





# PN Transmission Zone Reinforcement

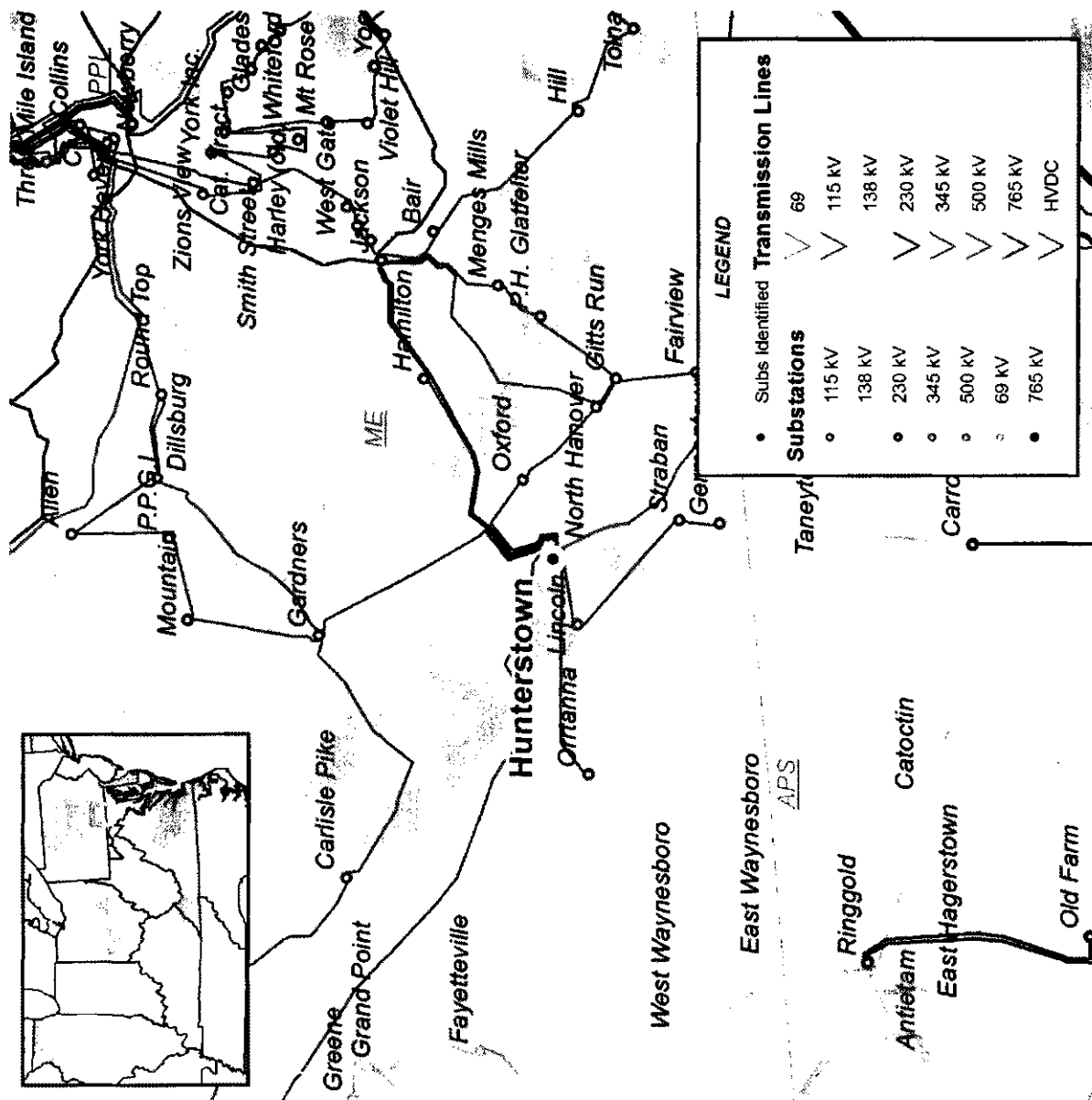
- Install a 100 MVAR Fast Switched Shunt and 100 MVAR Switched Shunt at Mainesburg 345 kV (existing base line upgrade b1802)
- Estimated Project Cost: \$6.1M
- Projected in-service date: 6/1/2015 (no advancement necessary)





## ME Violations

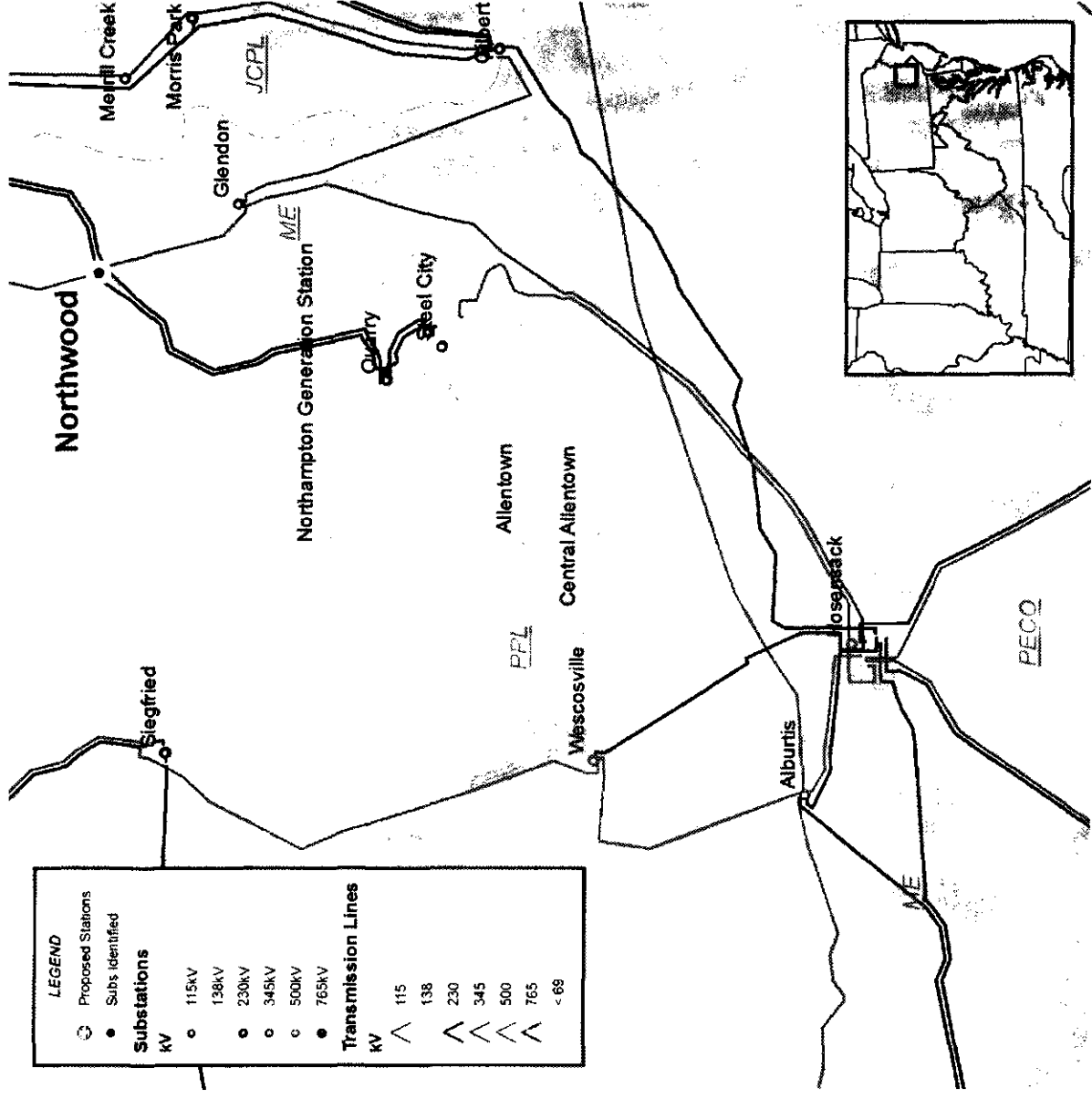
- Criteria violations
  - N-1-1 Thermal
  - N-1-1 Voltage
  - Generation Deliverability
- Multiple 230kV thermal violations
- Multiple 115kV low voltage violations
- Hunterstown 500kV low voltage
- Hunterstown 500kV and 230kV voltage drop





# ME Transmission Zone Reinforcement

- Northwood 230/115 kV transformer loads to 117.9% of its emergency rating of 274MVA for a loss of Portland 230/115kV transformer followed by the loss of Macr – Morr – Gilb 230kV.
- Northwood substation. Replace limiting wave trap, circuit breaker, substation conductor, relay and current transformer components.
- Estimated Project Cost: \$0.9M
- Projected in-service date: 6/1/2015





## ME Transmission Zone Reinforcement

- Glendon – Hosensack 115kV line loads to 102.6% of its emergency rating of 91MVA for the loss of Portland #3 transformer followed by the loss of Northwood – Quar + Northwood #6 transformer.
- Replace limiting wave trap on the Glendon - Hosensack line.
- Estimated Project Cost: \$0.05M
- Projected in-service date: 6/1/2015

